A global Forestry plan 2025 for Rodrigues Island

Architecture of project 2009-2025

http://www.arer.org – Sept. 2009

SOMMAIRE

Summary for citizen and policy makers

Aim: To establish a reforestation action plan and its bio-mass economic value within a strategic framework to mitigate the effects of climatic changes and to adapt the Island of Rodrigues to the new climate conditions.

For Rodrigues Island, as well as for every human being on our planet, Sustainable Development and Climate Change are interlinked. The historic of Rodrigues and the recent devolution of political power to the Regional Assembly of Rodrigues put the whole community of Rodrigues at a high level of responsibility for the future of the island and his inhabitants. How can we organize the Balancing Sustainable Development preoccupations in Rodrigues, when the impact of climate change on the islands of the Indian Ocean will continue to increase? From citizens to the highest level of State governance, everybody must act. The main conclusions of the Intergovernmental Panel for Climate Change (IPPC) Report 2007, underlined the need of urgent processes of adaptation to climate change for our small islands. Agriculture, forestry and ecosystem, water resources, human health, industry, settlement and society, all are concerned. Climate Change put Health and food security are placed at a high level of priority. The future of our islands conditions and Well Being value the process of adaptation.

From the Eden of Francois Leguat, the present forest scenery of Rodrigues is shocking. There is therefore an urgent need to systematically redo the forest of the island. Small Oceanic Islands with Devastated floras are a current situation. The State of the forest in Rodrigues creates an awareness to protect the biodiversity of the island. The Invasive species present in Rodrigues are also an opportunity of resources. Main actors involved and emergent projects of reforestation, and there is a real awareness in Rodrigues of the necessity to redo the forest cover of the island but the undertaking needs to be properly organized and managed in a more systematic way. A lot of efforts has been undertaken over the past 50 years to reforest the island and to protect the already reforested areas by the Forestry Service and by The Mauritian Wildlife Foundation, Rodrigues Branch.

The proposed Action Plan in the SIDPR "Sustainable Integrated Development Plan for Rodrigues" for forestry makes environment sustainability an integral part of development. Ensure energy security by targeting 100% energy electricity self-sufficiency by 2025 underlines another potential that should seriously be explored : the forestry/biomass, which could act as a major source of energy and as a major economic area of Rodrigues to adapt to climate change. The RAR - ARER 2007 report « Electricity Energy self-sufficiency strategy for Rodrigues, Review Climate Change Policies In view of Energy and Water Security Implications and economic development» proposed integration solutions for land management, building, agriculture and forest management, that are to be arbitrated. Frequent information actions, sensitization and communication with citizens and key players on the running policy and its progress, should be managed. The Rodriguan contributors of the ARER Report 2007 summarized their views as following: the forestry and the Biomass are some major energy and materials sources, an important economic sector and a crucial topic for Rodrigues to adapt to climate change. That could become a powerful creation of new employments.

What could be a global project of Forestry for Rodrigues in 2025? Sharing together an enlightened view of the project is a major step to the success! Managing a permanent debate among the whole community of Rodrigues in order to promote the project and mobilize the citizens. Issued from the SIDPR, 4 500 hectares of endemic and native forests on Rodrigues Island are to be exploited in a sustainable way in 2025, to compare to the actual 873 hectares of dense forest in 2009. Ten tree nurseries are needed to be in full exploitation and to produce one million of plants per year during 15 years, to compare to the two tree nurseries existing in 2009. Land Management should integrate the areas for each tree nursery. A detailed plan of the annual location, areas and cadastral identification numbers of Rodrigues forests to be planted is to be produced. At the beginning, implanting ten sites, each of ten hectares of forestry projects, in immediate connection with ten tree nurseries, acting as natural bioreactors spreading soon large amounts of seeds. Ten teams of 43 craftsmen, a whole big team is needed to realize this project, that implies 430 direct employments during 15 years. A team should be created as a Biomass Rodrigues Agency, in order to drive the whole global process. The permanent team and the global project for reforestation imply an investment of about 3 750 000 euro per year during 15 years. And this is just a part of the funds that are going back to Europe every year by lack of project from Rodrigues.

Of course, this architecture of project is just a first sketch to be concerted and debated, detailed, and to be negotiated with the whole community. The actual process of endemic and native reforestation on certain areas is a real success that every body can observe. Why not go on in a major plan to be implemented? This could be a first step in a long trip called Climate Change

"What could find Roland and Jeanine on Rodrigues Island in 2025?

At the beginning of the year 2025, two young peoples of just eighteen years should not be able to remember the Rodrigues landscape in 2009. They were much too young. But perhaps they have seen some pictures of the rodriguan south landscapes in the parents' houses. Even so it would be hard to believe: rocky buts in front of view with only hostile "Pican Loulou", vagrant animals like pigs, thin cows, poor looking sheeps and little goats everywhere, trying to survive by eating a poor grass, or whole areas of invasive species and houses without neither any trees nor gardens.

They should have no idea of how hard whose those times, how hard their parents and a lot of rodriguan peoples battled in those days and worked their whole time in order to implement the global forestry plan they project and realized together. Now, side by side on their solar boat, Roland and Jeanine contemplate those marvelous landscapes of agricultural, pastoral and forestry areas that are in full view. Gliding without noise on the emerald lagoon, they are enjoying the graceful rhythm of wind turbines producing a significant part of the green energy for Rodrigues. From time to time, some reflection issued from solar systems above roofs stick at their eyes.

The marine reserve, extended to the whole lagoon, is loaded with fish, turtles and shells. They are just back from the Rodriguan Aquaculture Corporation, where they acquired six pounds of "chevaquines". This big public-private corporation occupies a specific area in the lagoon. It produces enough sea foods for a whole range of needs for Rodrigues and also for exportation. Some others specific areas of the marine reserve are opened during precise timings to fisherman, who shift from fisherman to forester at the other times of the year.

As they cruise along a little armada of colored kite surfers enjoying the swell and the south east wind, our two young people cannot imagine the hard debates and talks all rodriguan share together in those all days, about the main topic involved to launch the global reforestation: "How can some order be brought and how can the sharing process be carried out regarding pastures, forests and agricultural lands?"

From those days, climate changes never stopped to move on, just increasing in full forces and impacting all nations on Earth. Now in 2025, tropical cyclones hit hard our islands in Indian Ocean. But by chance or because of the determination of the political leaders and the people to endorse a global action plan, the forestry politic launched in 2010 contributed to maintain sustainable and strong species of trees which are now remarkably fitted to this new climate conditions. The whole forests, as well as the vegetal hedges created along each meadow, field and pasturage, the trees planted around each house, minimize the erosion due to heavy precipitations. Soil keeps in place, thanks to the wisdom of the whole community of Rodrigues, which in those years launched the hard process of global reforestation. Trees also temperate the areas, in spite of a global increased temperature, and regulate the moisture in atmosphere, and the underground water.

A full range of products from biomass are now available, due to a very careful and sustainable exploitation of the forests: from food to biomass energy, from wood material for building and boats to useful products for the every day life, comprising beauty and medicinal useful bio oils. The 4 500 hectares of trees and shrubs of Rodrigues innerve a dynamic economic sectors for Rodrigues and also for exportations. And transform Rodrigues in an incredible big and pleasant Garden.

But news from the world are not as good as here, in a lot of small islands which didn't succeeded in building a global adaptation process of their territory. For a lot of human beings, the question is no to save the planet, as Terrans did put on scene the matter twenty years ago, but more modestly how to save the human specie from extinction. In their heart, they well know that Earth will survive to those strange inhabitants who in a few hundred years put the global terran ecosystem "sens dessus-dessous".

And each time Roland and Jeanine meet outsiders and strangers visiting Rodrigues, they just can't resist laughing at their round ball eyes, discovering the small and green Rodrigues delicately floating on a vast blue lagoon and a whole community sharing a peaceful and semi autonomous economy based on local products. And so, they grape one more time on their jobs they have just subscripted in the Rodriguan Biomass Agency , they engage a new session of training those strangers, coming here just to learn how to put in movement that same thing in their own countries. They are located in the educational and demonstrative François Leguat Reserve build in 2005, now a full forest of endemic species, acting as a bioreactor producing each day seeds and regeneration processes. They share during the days of the session that incredible feeling of a big and old forest from those ancient times when François Leguat lived on the island."

Chapter 1 - Rodrigues, Sustainable development and Climate Change interlinked

RODRIGUES ISLAND

Rodrigues (figure 1) is an island of the Republic of Mauritius and of volcanic in origin. It is situated latitude 19 degrees 43' south and 63 degrees 21' east 320 nautical miles (650 kilometers) east of Mauritius. It covers an area of 110 km square and is the smallest and oldest island of the Mascarene Archipelago. The island has mountainous topography with its highest peak rising to 400 km (Mount Limon) and is completely surrounded by a fringing coral reef of a length of 90 km enclosing a wide lagoon.

The vast insular shelf of a length of 55 km and a width of 30km, with a 950 km square surface area to the 200 meters isobaths on which the island stands, has favored the development of a reef complex which is over 200 km square in area.

Of this surface only a small percentage is currently covered by viable coral surface, thus reducing the productive potential of the lagoon. Extensive deforestation on the island has led to siltation on the reef and has contributed to the noticeable decline in reef catches. The productivity of the oceanic water surrounding the island is about 0-25 TC/km square/year. Spring tides have amplitude of 1.2 m which is greater than in the other Mascarene Islands. The fishable area of Rodrigues amounts to 16 830 sq km compared to Mauritius 1 208 sq km.
Rodrigues has a population of 37,000 people. Its economic activities are mainly agriculture, fishing and tourism.

POPULATION DEVELOPMENT AND THE ENVIRONMENT

Historical Overview

Named in 1528 after the Portuguese captain, Diego Rodriguez, Rodrigues has known several visits by passing ships and navigators (mainly the Dutch) over the next 150 years. The first known human settlement was by Francois Leguat and his seven companions who stay on the island from 1691 to 1693.
After the departure of the Leguat's group in 1693 and a short spell (1725) of Julien Tafforet and about four men, the next initiave to colonise the island came from Mahe Labourdonnais, Governor of Mauritius in 1735 mainly for the collection of land tortoises and sea turtles for food. Extinction of these megafauna was inevitable to due to the massive exploitation and the damage done to the fragile ecosystem in term of lost of natural biodiversity was irreversible.

The island stayed a french colony and an industry based on agriculture and livestock took off the governorship of Philibert Marragon until the capture of the island by the British in 1809. From then on the island stayed under British rule until the independence of Mauritius in 1968.

Devolution of political power

To give more decision powers to Rodrigues, the Government of the Republic of Mauritus granted a form of autonomy and the law (The Rodrigues Regional Assembly Act) was voted by the National Assembly in November 2001 to include the autonomy of Rodrigues in the National Constitution.

Changes in population size, its composition and its regional distribution are interlinked with the environment in many different ways. It is important to point out that it is generally not the number of people per se that affects the natural environment, but the number of people in conjunction with their technologies, styles of life and forms of socio-economic organization.

With given technology and given style of life the requirements from the environment are proportional to the number of people. Twice as many people cooking with the same wood stoves use up twice as much wood. Twice as many cars of a given kind and given condition of repair put twice as much carbon dioxide into the atmosphere. Twice as many fish eaters require twice as large a catch. With all else constant, the requirements are the simplest possible linear function of the number of people.

Consumption may be a linear function of population when technology and style of life are given, but the resulting strain on the environment is distinctly nonlinear. Once the woodcutting or fish consumption outpace the normal mortality of trees or the reproductive capacity of the fish, then any increment of population (again with given technology and style of life) changes the ecology, and changes it permanently if populations do not decrease or, in some circumstances, even if they do decrease.

From 1976 to 1989, over 15 years the population living on Rodrigues increased by more than 50% to reache 37,000. This very rapid increase was mostly due to a large surplus of births over deaths. Especially during the years 1980-83, there were up to five times more births than deaths registered. In 1980 the crude fertility rate in Rodrigues was about the same level as in Kenya or other very high fertility countries in Africa. With death rates at a level of 8.3 per 1000 in 1980, the population showed a record natural growth of almost 4% per year.

Since 1980 birth rates have declined dramatically. This indicates that the fertility transitions came to the island of Rodrigues some 20 years later than to the island of Mauritius. However it needs to point out that the present population living on Rodrigues is rather constant because of the huge wave of emigration of the young people to Mauritius and elsewhere since the mid 1980s looking for employment.
In a study by UNICEF in 1998, the following remark was made; "the Rodrigues' population is an ageing population."

Sustainable development in Rodrigues

Sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

"Our common Future" Report of the Bruntland Commission (United Nations, 1987)

At the United Nations Conference on Environment and Development, also known as the Earth Summit, (held in Rio de Janeiro in June 1992), the international community agreed on a global framework for sustainable development, comprising two agreements (non-binding).

- The Rio Declaration on Environment and Development, which sets out the principles for human interaction with the environment; and
- Agenda 21, which formed the international guideline and action plan for sustainable development.

All 180 countries present, including Mauritius, adopted the so called Local Agenda 21, which translates the Agenda 21 Action Plan for Sustainable Development into a participatory, multisectoral process to achieve the goals of Agenda 21 through a programme of action at local level.

As a result, each local community, including the RRA, has the responsibility to determine its own priorities, policies and actions of their respective development agenda. The RRA, for instance, has to proceed recognizing the overarching goals of Local Agenda 21 process, which are to:

- Raise awareness of environmental and sustainability issues amongst all citizens;
- Maximize the support and involvement of local communities and businesses;
- Pursue economic development and social progress whilst limiting the impact on environmental resources and fragile ecosystems;
- Reduce the consumption of all natural resources;
- Maximize energy efficiency and the proportion of energy from renewable resources;
- Conserve and enhance green space and diversity of wildlife;
- Encourage all organizations and individuals to adopt sustainable practices and lifestyles;
- Minimize levels of pollution; and
- Minimize the environmental impact of waste and to promote the reduction, re-use and recycling of resources.

The Local Agenda 21 needs to be adapted to suit local needs and circumstances to address the following:

- Address economic, social and ecological needs in an integrated way;
- Include a shared vision for a long term sustainable future;
- Include a participatory process with all local role-players including communities, interest groups, the private sector and shareholders of the community;
- Establish stakeholder groups, forum or equivalent multi-sectoral community groups to oversee process;
- Prepare an action plan with concrete targets;
- Establish a monitoring and reporting framework; and
- Establish indicators to monitor progress.

"Sustainable development is a process which enables all people to realize their potential and improve their quality of life in ways which protect and enhance the Earth's life support systems."

Sustainable Development thus encompasses three general policy areas:

Environmental: Rodrigues environmental sustainability is the ability of the environment to function properly indefinitely; i.e., human activity only uses nature's resources at a rate at which they can be replenish naturally.

Economic: "The widely accepted definition of economic sustainability is maintenance of capital, or keeping capital intact. Thus Hick's definition of income – the amount one can consume during a period and still be as well off at the end of the period – can define economic sustainability as it devolves on consumed value-added (interest), rather than capital." Robert Goodland (World Bank)

Social: Social Sustainability encompasses three components:

- Basic needs such as housing and sufficient income that must be met before capacity can develop;
- Individual or human capacity or opportunity for learning and self-development; and
- Social or community capacity for the development of community organisations, and networks that foster interaction.

The above components are underpinned by four guiding principles, namely Equity; Social inclusion and Interaction; Security; and Adaptability.
(Policy Report on Social Development, City of Vancouver, 2005)

Economic: Economic sustainability is defined as follows: "The widely accepted definition of economic sustainability is maintenance of capital, or keeping capital intact. Thus Hick's definition of income – the amount one can consume during a period and still be as well off at the end of the period – can define economic sustainability as it devolves on consuming value-added (interest), rather than capital." – Robert Goodland (World Bank) in Encyclopaedia of Global Environmental Change ,2002.

Environment: Environmental Sustainability is the ability of the environment to function properly indefinitely, i.e., human activity only uses nature's resources at a rate which they can be replenished naturally.

Balancing Sustainable Development preoccupations in Rodrigues

Sustainable development necessarily implies compromise between environment and development. Rodrigues has specificities that require a proper balancing of the three preoccupations – Environmental, Social and Economic.

Policy makers, the private sector as well as Civil Society should be guided by not only what is bearable, viable, or equitable, but more importantly sustainable indefinitely; hence the definition:

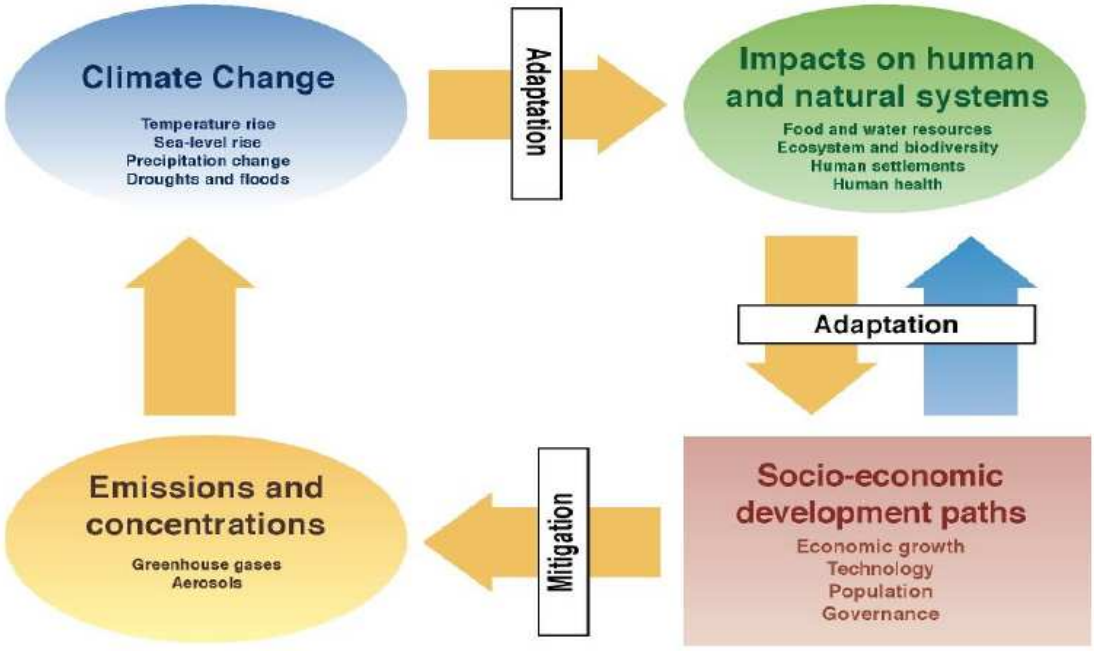
"Sustainable development is a socio-ecological process characterized by the fulfillment of Rodriguan needs while maintaining the quality of the natural environment indefinitely."

Unless men, women, and children change their behavior with regards to the use of natural and man-made resources there is little, if any, hope for sustainable development. USAID (1996)

Climate Change and sustainable development are stongly linked

Sustainable development and climate change are interdependent

Figure 1: synoptic CC/DD - WG3 - WG2 IPPC -February 2005 Saint Denis Reunion



The impact of climate change on the islands of the Indian Ocean will continue to increase. From citizens to the highest level of State governance, everybody must act.

Sustainable development amongst insulated societies is only meaningful if it takes into account the immediacy of climate change, considers the capacity of adaptation of human societies to this serious phenomenon and works towards for a reduction in greenhouse gas emissions (see the 2007 GIEC report). The majority of Indian Ocean islands do not currently have an operational strategy of greenhouse gas emission reductions, even though these islands have considerable renewable energy resources. We must make it a priority to continually mobilize Presidents, Ministers and actors in economic and civil society, because sustainable development is not possible without a stable energy system.

The main conclusions of the IPPC Report 2007 underlined the need of urgent process of adaptation for our small islands to climate change

7.7 Conclusions: implications for sustainable development

Sustainable development is largely about people, their well-being, and equity in their relationships with each other, in a context where nature-society imbalances can threaten economic and social stability. Because climate change, its drivers, its impacts and its policy responses will interact with economic production and services, human settlements and human societies, climate change is likely to be a significant factor in the sustainable development of many areas (e.g., Downing, 2002). Simply stated, climate change has the potential to affect many aspects of human development, positively or negatively, depending on the geographic location, the economic sector, and the level of economic and social development already attained

Agriculture, forestry and ecosystem, water resources, human health, industry, settlement and society, all are concerned

Phenomenon[a] and direction of trend	Likelihood of future trends based on projections for 21st century using SRES scenarios	Examples of major projected impacts by sector			
		Agriculture, forestry and ecosystems [4.4, 5.4]	Water resources [3.4]	Human health [8.2, 8.4]	Industry, settlement and society [7.4]
Over most land areas, warmer and fewer cold days and nights, warmer and more frequent hot days and nights	Virtually certain[b]	Increased yields in colder environments; decreased yields in warmer environments; increased insect outbreaks	Effects on water resources relying on snow melt; effects on some water supplies	Reduced human mortality from decreased cold exposure	Reduced energy demand for heating; increased demand for cooling; declining air quality in cities; reduced disruption to transport due to snow, ice; effects on winter tourism
Warm spells/heat waves. Frequency increases over most land areas	Very likely	Reduced yields in warmer regions due to heat stress; increased danger of wildfire	Increased water demand; water quality problems, e.g., algal blooms	Increased risk of heat-related mortality, especially for the elderly, chronically sick, very young and socially-isolated	Reduction in quality of life for people in warm areas without appropriate housing; impacts on the elderly, very young and poor
Heavy precipitation events. Frequency increases over most areas	Very likely	Damage to crops; soil erosion, inability to cultivate land due to waterlogging of soils	Adverse effects on quality of surface and groundwater; contamination of water supply; water scarcity may be relieved	Increased risk of deaths, injuries and infectious, respiratory and skin diseases	Disruption of settlements, commerce, transport and societies due to flooding; pressures on urban and rural infrastructures; loss of property
Area affected by drought increases	Likely	Land degradation; lower yields/crop damage and failure; increased livestock deaths; increased risk of wildfire	More widespread water stress	Increased risk of food and water shortage; increased risk of malnutrition; increased risk of water- and food-borne diseases	Water shortages for settlements, industry and societies; reduced hydropower generation potentials; potential for population migration
Intense tropical cyclone activity increases	Likely	Damage to crops; windthrow (uprooting) of trees; damage to coral reefs	Power outages causing disruption of public water supply	Increased risk of deaths, injuries, water- and food-borne diseases; post-traumatic stress disorders	Disruption by flood and high winds; withdrawal of risk coverage in vulnerable areas by private insurers, potential for population migrations, loss of property
Increased incidence of extreme high sea level (excludes tsunamis)[c]	Likely[d]	Salinisation of irrigation water, estuaries and freshwater systems	Decreased freshwater availability due to saltwater intrusion	Increased risk of deaths and injuries by drowning in floods; migration-related health effects	Costs of coastal protection versus costs of land-use relocation; potential for movement of populations and infrastructure; also see tropical cyclones above

[a] See Working Group I Fourth Assessment Table 3.7 for further details regarding definitions.
[b] Warming of the most extreme days and nights each year.
[c] Extreme high sea level depends on average sea level and on regional weather systems. It is defined as the highest 1% of hourly values of observed sea level at a station for a given reference period.
[d] In all scenarios, the projected global average sea level at 2100 is higher than in the reference period [Working Group I Fourth Assessment 10.6]. The effect of changes in regional weather systems on sea level extremes has not been assessed.

Table SPM.1. *Examples of possible impacts of climate change due to changes in extreme weather and climate events, based on projections to the mid- to late 21st century. These do not take into account any changes or developments in adaptive capacity. Examples of all entries are to be found in chapters in the full Assessment (see source at top of columns). The first two columns of the table (shaded yellow) are taken directly from the Working Group I Fourth Assessment (Table SPM-2). The likelihood estimates in Column 2 relate to the phenomena listed in Column 1.*

Climate Change and Health impact

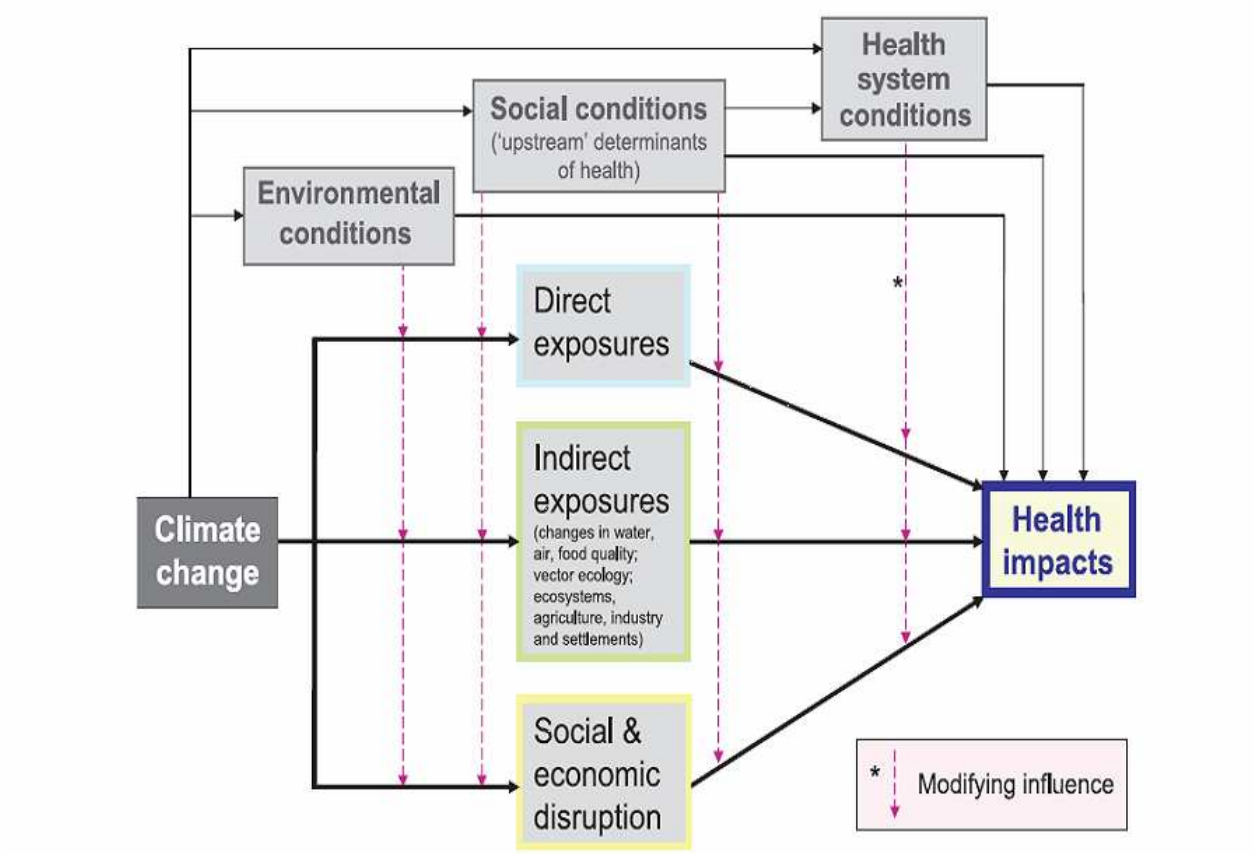


Figure 8.1. *Schematic diagram of pathways by which climate change affects health, and concurrent direct-acting and modifying (conditioning) influences of environmental, social and health-system factors.*

Climate Change and food security

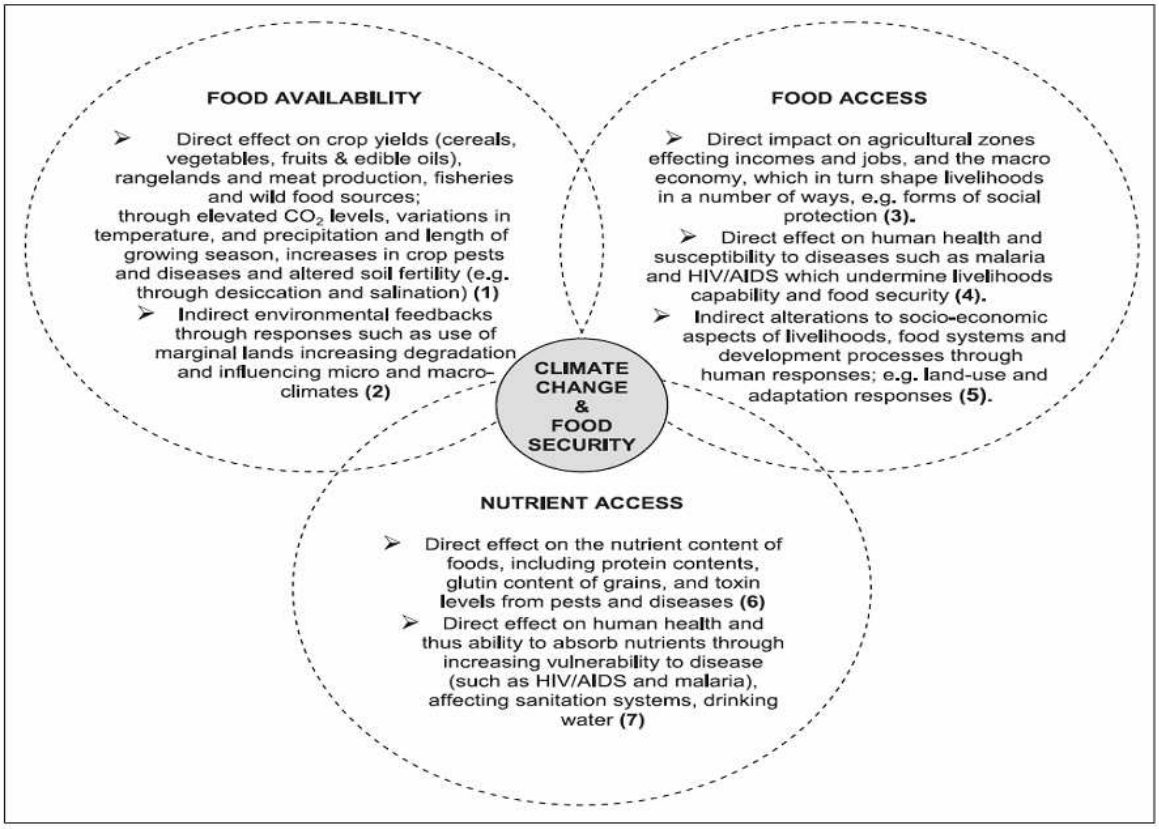


Figure 9.6. *Linkages identified between climate change in Africa and three major components of food security. Adapted from inputs of (1) Swaminathan, 2000; Fischer et al., 2002; Turpie et al., 2002; Rosegrant and Cline, 2003; Slingo et al., 2005. (2) Fischer et al., 2002; Slingo et al., 2005. (3) Turpie et al., 2002; African Union, 2005. (4) Piot and Pinstrup-Anderson, 2002; Turpie et al., 2002; Mano et al., 2003; USAID, 2003; Gommes et al., 2004; van Lieshout et al., 2004. (5) Adger and Vincent, 2005; Brooks et al., 2005; Gregory et al., 2005; Thomas and Twyman, 2005; O'Brien, 2006. (6) Slingo et al., 2005. (7) Swaminathan, 2000; Schulze et al., 2001; Gommes et al., 2004.*

Future Islands Conditions and Well Being, the value of Adaptation

Box 16.4. Future island conditions and well-being: the value of adaptation

Global change and regional/local change will interact to impact small islands in the future. Both have physical and human dimensions. Two groups of global drivers are identified in the top panel of Figure 16.2: first, climate change including global warming and sea-level rise and, second, externally driven socio-economic changes such as the globalisation of economic activity and international trade (Singh and Grünbühel, 2003). In addition to these global processes, small islands are also subject to important local change influences, such as population pressure and urbanisation, which increase demand on the local resource base and expand the ecological footprint (Pelling and Uitto, 2001).

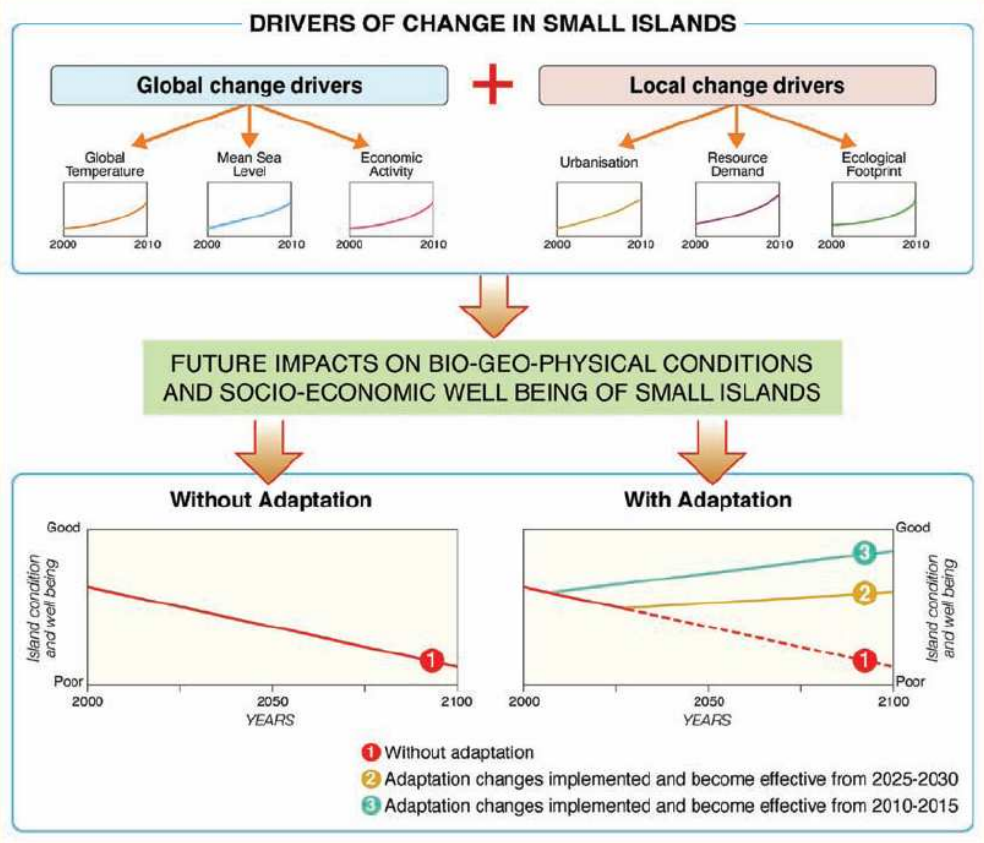


Figure 16.2. *Drivers of change in small islands and the implications for island condition and well-being under no adaptation and the near-term and mid-term implementation of adaptation. Adapted from Harvey et al. (2004).*

The value of adaptation for islands

Box 16.7. Capacity building for development of adaptation measures in small islands: a community approach

Capacity building for development of adaptation measures in Pacific island countries uses a Community Vulnerability and Adaptation Assessment and Action approach. Such an approach is participatory, aims to better understand the nature of community vulnerability, and identifies opportunities for strengthening the adaptive capacity of communities. It seeks to promote a combination of bottom-up and top-down mechanisms for implementation, and supports the engagement of local stakeholders at each stage of the assessment process. If successful, this should enable integration or 'mainstreaming' of adaptation into national development planning and local decision-making processes. The main steps of this approach are outlined below (Figure 16.3).

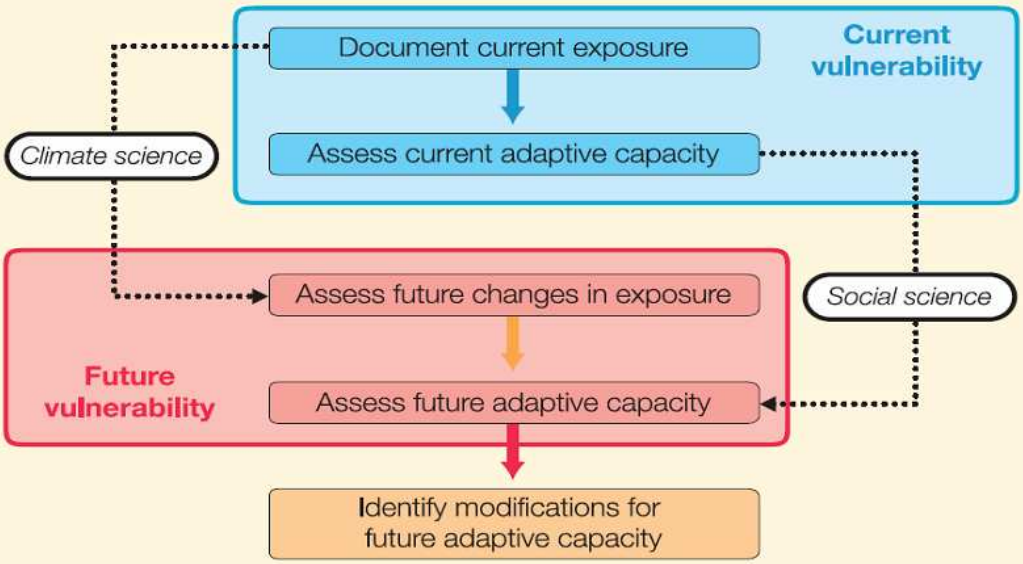


Figure 16.3. *The main steps of a community vulnerability and adaptation assessment and action approach.*

Chapter 2 – Forestry in Rodrigues Island, historical overview and state of the art in 2009

From the Eden of Francois Leguat the present forest scenery of Rodrigues is shocking. There is therefore an urgent need to systematically redo the forest of the island.

A lot of efforts has been undertaken over the past 50 years to reforest the island and to protect the already reforested areas.

From the Eden of Francois Leguat the present forest scenery of Rodrigues is shocking. What remains of the pristine forest are but a few patches of badly degraded forest covers. The degradation over the years due to various factors particularly human activities has reached a serious state which could jeopardize sustainable development. Rodrigues is not unique in having a highly endangered flora due to the influence of man but the consequences of human interference have put Rodrigues near the top of the list of small oceanic islands with devasted flora. However, with careful conservation management the outlook is good and we should be able to conserve what remains. There is therefore an urgent need to systematically redo the forest of the island. It is to be noted that already a lot of efforts has been undertaken over the past 50 years to reforest the island and to protect the already reforested areas.

Small Oceanic Islands with Devastated floras

Numbers of endemic taxa

	(sq.km)	Ex	E	R	I	?	nt	Total	Ex or threatened
Ascension Island	94	1	5	4		1		11	10 (91%)
Norfolk Island	39	3	9		5	2	1	48	45 (94%)
Rodrigues	109	8	22	9			2	49	46 (94%)
St Helena	121	7	23	17		2		49	47 (96%)

From Threatened Plants Unit, World Conservation Monitoring Centre, 1989
Key: Ex = Extinct, E = Endangered, V = Vulnerable, R = Rare, I = Indeterminate,? = no information, nt = Not Threatened.

State of the forest in Rodrigues, awareness to protect the biodiversity of the island

Total area of Rodrigues is about 10,900 hectares and about 23% is considered to be covered by forest but according to the latest information some 3,460 hectares (31.74%) are considered as forest land. The reforestation programme over the past years has consisted mainly in the planting of exotic species. However over the past 15 years, endemic and indigenous species have been propagated in a number of locations such as Grande Montagne Nature Reserves, Anse Quitor Nature Reserve, Ilot Cocos Nature Reserve and Francois Leguat Giant Tortoise & Cave Reserve. The two main actors in forestry in Rodrigues are the Forestry Department and the Mauritian Wildlife Foundation.

The latter essentially concentrates on conservation and propagation of the endemic and indigenous species, creating awareness through education of the importance to protect the biodiversity of the island. This enterprise has been very successful in Rodrigues. Rodrigues has one of the earliest nurseries in the Republic of Mauritius, where there has been a

continuous effort to propagate endangered plants since 1982. The growth of plants for reintroduction increased from 1990-1995 when 8000 plants of 25 species were produced. Since 1996 there has been a purpose-built nursery with the capacity to produce up to 75,000 plants a year. The Mauritian Wildlife Foundation continues its effort to this day as a major partner in the conservation, restoration and reforestation fields.

The Forest Department is the official institution responsible for all forest land in Rodrigues. It used to have under its responsibility several nurseries all over the island. Today there are only two remained, Solitude and Baie Aux Huitres. For years, the Forest Department concentrated on planting only exotic plants to meet the need of the population in wood. Today there is a shift towards propagating and indigenous species but in conjunction the planting of exotic species continues. The tragedy is that most of the exotics are potentially invasive species. On Rodrigues there are about 305 naturalized species of plants that now comprises 78% of the flora. Island ecosystems extensively modified by human activities are much more susceptible to alien plants than are pristine islands, and tropical islands are probably more susceptible to invasion than islands in temperate regions.

Invasive species present in Rodrigues

Some of the invasive species present in Rodrigues are:

- Ravenala madagascariensis (ravinal)
- Syzygium jambos (jamrosa)
- Litsea glutinosa (bois d'oiseau)
- Furcraea foetida (aloes)
- Lantana camara (vielle fille)
- Leucaena Leucocephala (accacia)
- Acacia nilotica

Low regeneration of some native Rodrigues plants due to competition from invasive plants and grazing of domestic livestocks.

Main actors involved and emergent projects of reforestation

Under the European Development Fund, some 1082 hectares were parcelled out for sylvo-pastoral purposes during the 1980 -1990s. Recently the commission of Agriculture has started the rehabilitation of 112 hectares sylvo-pastoral land aiming at planting 80,000 endemic plants and 20,000 thousand fodder cuttings.

The Mauritian Wildlife Foundation, Rodrigues Branch is pursuing its conservation and restoration project with the help of the Decentralised Corporation Programme financed by the European Union, has recently planted 45,000 endemic and native plants on Grande Montagne and about 15,000 plants on Ile aux Cocos, the bird sanctuary Ilet. In patnership with the National Aviation Company, Air Mauritius; the MauWF has undertaken the planting of 6000 plants at the Natural Reserve of Anse Quitor.

The forest department is also involved in the reforestation of the three natural reserves in parnership with the local NGOs. The village communities are also involved in the reforestation of the island; for example the recent projects are at Baie Malgache and Riviere Banane.

The private sectors are also directly involved in the reforestation of the island. The Francois Leguat Giant Tortoise and Cave Reserve, a pioneer in this undertaking, has planted 115,000 endemic and native plants over a surface area of 12 hectares over the past five years and is

aiming at reaching 300,000 to complete the reforestation of the entire 19hectares reserve in the coming years. The Reserve is situation at Anse Quitor in the limestone area of the south west of Rodrigues that lies adjacent to the Anse Quitor Natural Reserve.

A new project at Pointe Source on the North East of the island is planning to rehabilitating and reforesting some 79 hectares of degrading land.

There is a real awareness in Rodrigues of the necessity to redo the forest cover of the island but the undertaking needs to be properly organized and managed in a more systematic way

From the above, we can infer that there is a real awareness in Rodrigues of the necessity to redo the forest cover of the island but the undertaking needs to be properly organized and managed in a more systematic way. It is therefore imperative that all the stakeholders; public, private and civil societies concerted their efforts to achieve the Millenium Development Goal's (MDGs) of a forest cover of 35 percent by 2025.

According to the latest GIS survey, 3 460hectares (31.74%) of the total surface area of Rodrigues (10 900hectares) are covered with some vegetation but only about 830 ha is dense forest with more than 400 trees per hectare. The rest is mostly much degraded forest. The surface area covered with good forest amounts to about 7.61% and is mostly consisted of exotic species such as:

Scientific Name	Common Name
Casuarina equisetifolia – subsp. equisetifolia	Filao
Tabebuia pallida	Tecoma
Vitex glabrata	Vitex
Terminalia arjuna	Rajuna
Acacia nilotica	Piquant Loulou
Eucalyptus tereticornis	Icalyptis

The exotic species provides wood for different needs of the Rodriguan people but due to their invasive tendencies; they are exerting a lot of pressure on what is left of the endemic and native species. They are also probably one of the causes for the extinction of a number of endemic and native species. This is why all the stakeholders have now engaged in implementing a policy of gradually reducing the exotic species by endemic and native species. One example of highly invasive plant species is the Acacia nilotica and the Regional Government of Rodrigues through the Commission of Agriculture and Natural Resources is now fully committed to control the propagation of the plant and to eventually eradicate it altogether. The acquisition of a new heavy duty shredder machine by the Commission of Agriculture is a concrete example of the will of the government to address the problem caused by alien invasive species.

Proposed Action Plan in the SIDPR "Sustainable Integrated Development Plan for Rodrigues" for forestry

In the line with the newly released SIDPR (Sustainable Integrated Development Plan for Rodrigues – "Plan de Development Durable"), the following proposed strategy aims at providing baseline information for a comprehensive action plan to achieve the forest cover MDGs for Rodrigues by 2025.

The SIPDR report 1.3.3: "Integrate environment in key sectors and in policy-making." "With regards to environment sustainability, the following are proposed:

Make environment sustainability an integral part of development. (Step 7)

Environment needs to be fully integrated in key sectors of the economy. This implies inter alia ensuring the sustainable management of the natural resources and the environment while minimizing the environmental impact of increased development. The strategy is such that natural resource management will contribute to poverty alleviation and enhance human welfare.

Thus, the definition of environmental sustainability given by Daly (which comprises both an output and an imput rule) is mainstreamed in policy-making. This calls for a new approach to Land Use and Land Resources, Coastal Zone Management, and the environment in general, whereby planning and management are given utmost consideration. How does this get done?

Identify key environmental issues in each sector, namely Agriculture; Forest Management; Fisheries & Aquaculture; Hospitality, Tourism & Handicrafts; Water & Sanitation; Health; Education; Energy; Transport & Logistics; Wholesale, retail and other type of businesses;

- Mainstream "climate proofing" into national Development Strategies (Step 10)
- Launch a bold Eau-de-Rodrigues Initiative as part of a holistic Integrated Water Resource Management planning process.
- Information resources – GIS

Ensure energy security by targeting 100% energy electricity self-sufficiency by 2025 - Another potential that should seriously be explored is the forestry/biomass, which could act as a major source of energy and a major economic area of Rodrigues to adapt to climate change.

Following the release of the Agence Regionale de l'Energie Reunion (ARER) report in 2007 conducted for the Regional Assembly of Rodrigues, the potential for achieving this target within the next two decades appear non-negligible. In short terms, emphasis should be laid on solar and wind systems. The challenge is to make the solar form of energy accessible to all, particularly the most vulnerable ones. In the medium, photovoltaic systems and wind energy should be installed on a wider "farm" scale. Wind turbines and Photovoltaic systems for water pumping are recommended in the longer term for the desalination plants. Another potential that should seriously be explored is the forestry/biomass, which could act as a major source of energy and a major area of Rodrigues to adapt to climate change.

The long-term strategy contained in the SIDPR emphasizes energy management and disaster preparedness as well as the urgency to develop partnerships with islands of the Indian Ocean."

RAR - ARER 2007 report « Electricity Energy self-sufficiency strategy for Rodrigues, Review Climate Change Policies In View of Energy and Water Security Implications and economic development»

In the detailed report ARER 2007 referenced in the SIDPR, " Electricity Energy self-sufficiency strategy for Rodrigues, security supply, Sustainable Development and Climate Change, 100% Renewable energy - 2007-2012-2020 Energy at the heart of sustainable development and

water management « Review Climate Change Policies In View Of Energy and Water Security Implications » "Rodrigues Island of Nature, Sun and Wind!" some crucial issues are underlined:

> ***Integration solutions for land management, building, agriculture and forest management are to be arbitrated. Frequent information actions, sensitization and communication with citizens and key players on the running policy and its progress, must be managed.***

Reforestation and biomass development is considered as a multiple economic sector and a key action to prepare the island to climate change. The story of reforestation in Rodrigues has implanted a real know-how there, means and a precious wood capital to be sustainably managed, with the assistance of the Rodrigues Regional Assembly forestry department. A private initiative for the reforestation of endemic plants capitalizes the acquired experience: the Anse Quittor tourist park. Some of the species represent a problem for water resources. The surface area at stake, reforestation potential, wood availability, today's means, priorities. « Priorities must be set for land management policy: particularly reforesting against climate change » - dixit the symposium participants.

Rodrigues Island now entails political, technical and land management choices: « How can some order be brought and how can the sharing process be carried out regarding pastures, forests and agricultural lands? ». Various scenarios are standing out, the functions of the decisions to be taken, for diversifying and reinforcing the means. An economic activity of existing wood cutting and transformation is necessary. Energy wood for gasification is a real opportunity. In what ways can the biomass policy become an operational programme fighting against climate change? Synthetic presentation of the global action programme to be set up in details in a future specific technical meeting with Rodriguan experts.

The Territory management project needs to organize a programming meeting to integrate this biomass plan into the Rogriguan territory management programme."

Table 9.10: *Sustainable development implications of forestry mitigation*

Activity category	*Sustainable development implications*		
	Social	**Economic**	**Environmental**
A. Increasing or maintaining the forest area			
Reducing deforestation and forest degradation	*Positive* Promotes livelihood.	*Positive or negative* Provides sustained income for poor communities. Forest protection may reduce local incomes.	*Positive* Biodiversity conservation. Watershed protection. Soil protection. Amenity values (Nature reserves, etc.)
Afforestation/ reforestation	*Positive or negative* Promotes livelihood. Slows population migration to other areas (when a less intense land use is replaced). Displacement of people may occur if the former activity is stopped, and alternate activities are not provided. Influx of outside population has impacts on local population.	*Positive or negative* Creation of employment (when less intense land use is replaced). Increase/decrease of the income of local communities. Provision of forest products (fuelwood, fibre, food construction materials) and other services.	*Positive or negative* Impacts on biodiversity at the tree, stand, or landscape level depend on the ecological context in which they are found. Potential negative impacts in case on biodiversity conservation (mono-specific plantations replacing biodiverse grasslands or shrub lands). Watershed protection (except if water-hungry species are used) . Losses in stream flow. Soil protection. Soil properties might be negatively affected.
B. Changing to sustainable forest management			
Forest management in plantations	*Positive* Promotes livelihood.	*Positive* Creation of employment Increase of the income of local communities. Provision of forest products (fuelwood, fibre, food, construction materials) and other services.	*Positive* Enhance positive impacts and minimize negative implications on biodiversity, water and soils.
Sustainable forest management in native forest	*Positive* Promotes livelihood.	*Positive* Creation of employment. Increase of the income of local communities. Provision of forest products (fuelwood, fibre, food, construction materials) and other services.	*Positive* Sustainable management prevents forest degradation, conserves biodiversity and protects watersheds and soils.
C. Substitution of energy intensive materials			
Substitution of fossil intensive products by wood products	*Positive or negative* Forest owners may benefit. Potential for competition with the agricultural sector (food production, etc.).	*Positive* Increased local income and employment in rural and urban areas. Potential diversification of local economies. Reduced imports.	*Negative* Non-sustainable harvest may lead to loss of forests, biodiversity and soil.
D. Bioenergy			
Bioenergy production from forestry	*Positive or negative* Forest owners may benefit. Potential for competition with the agricultural sector (food production, etc.)	*Positive or negative* Increased local income and employment. Potential diversification of local economies. Provision of renewable and independent energy source. Potential competition with the agricultural sector (food production, etc.)	*Positive or negative* Benefits if production of fuelwood is done in a sustainable way. Mono specific short rotation plantations for energy may negatively affect biodiversity, water and soils, depending on site conditions.

The Rodriguan contributors of the ARER Report 2007 summarized their views as following : the forestry and the Biomass are major energy sources, an important economic sector and a crucial topic for Rodrigues to adapt to climate change et to create a powerful creation of employment

Forested area of Rodrigues in 2007 is around 3,500 hectares, of a total island surface area of 10,000 hectares. There is realistic potential for a further 1,000 hectares of forest, which would lead to a total of 4,500 hectares of exploitable forest. The quantity of exploitable wood would be around 150,000m3, 10% of which would be from renewable sources.

Advantages: good experience, available funding within the CDM framework, wood potential for a wood energy sector linked with a system of gasification. The reintroduction of endemic species shows initial promise. Coconut trees, bamboo and the Mourong Baton are growing well and have diverse economic and environmental potential. With real political will, the wood industry and the biomass industry in general, can contribute significantly to energy self-sufficiency in Rodrigues, making use of gasification with a potential base of 1 megawatt of electrical production.

Drawbacks : centralised actions which are not widespread and little known, little possibility of private projects, length of return on the plots, lack of funding and means, decisions to be made on the division of land use, lack of communication with the population regards climate change and the need for a plan of economic development and adaptation to climate change.
Biomass - plan of potential actions for short term implementation, with the aim of preparing the island for climate change

Development of an economic sector "Wood", general reforestation of the island with a minimum of 1,000 hectares of endemic species, 2,000 hectares is possible, giving a future total of 4,500 to 5,500 hectares of forest, out of a total island surface area of 10,000 hectares.

- Development of an economic sector "Coconut trees" plantation of a row of trees along the island perimeter where it is possible, (50 hectares, which represents potentially 10,000 coconut trees).
- Development of a multi-functioning ecological sector for houses and gardens of the island: bamboo, Mourong Baton and banana trees for the 11,000 houses on Rodrigues. There is a potential problem of space on certain plots for this project.
- Establishment of forest village projects: bamboo, vacoas, vetiver, medicinal plants, i.e. 90 village forests with a potential of one or two hectares per village.
- Investment in a unit of gasification of biomass: for the electrical production and heating for energy self-sufficiency of the island.
- Reinstating the waste depot at Roche Bon Dieu: at the Grenade site in the context of the ecological industrial zone of Grenade.

Chapter 3 - What could be a global project of Forestry for Rodrigues in 2025?

Sharing together an enlightened view of the project is a major step to the success!

The needed scale of project to adapt Rodrigues to climate change as well as to create a dynamic economic sector which aims to develop co products issued from forestry, agriculture, and bioressources, implies a strong phase of debate to sustain the emergent awareness among the rodriguan community, as well as among the leader of the Republic of Mauritius.

"Help yourself planting 15 000 000 trees during 15 years on Rodrigues Island"

Well, ok, nothing is sure about producing an enlightened view of a project! However, planting 15,000,000 trees during 15 years on Rodrigues Island is just using a biotechnology which is known as very efficient.

That is the main task of the political leaders of Rodrigues to design the path to follow, and they now engage in 2009 a vast talking about the SIDPR, a vast talking among Rodriguan people to promote the sustainable plan for Rodrigues. That's great! Yes, that is really a great opportunity: there is no need for new reports, there is no more time spared, but only for decision and concerted actions, the whole administration of Rodrigues as well as each citizen and association can undertake this big building project, without waiting for any other help, not any other help than these Man and Women of good willing. "Help yourself and God will help you".

Managing a permanent talk among the whole community of Rodrigues in order to promote the project and mobilize the citizens

Organizing an informal group of citizens and economic actors acting as promoters and explicating in different lines the content of the project, working with the villages' communities, debating with the RAR, mobilizing interests, showing the efficient results of the first experiences conducted...

Issued from the SIDPR, 4 500 hectares of endemic and native forests on Rodrigues Island are to be in a sustainable exploitation in 2025 to compare to the actual 873 hectares of dense forest in 2009

The Island of Rodrigues covers an area of 11 000 hectares.1 000 hectares of forest are actually identified on Rodrigues Island. 80 % should be composed of exotic species and 20 % of endemic or native species. The global target for forest in Rodrigues is of 4 500 hectares. So the minima to engage over the next 15 years, is about 200 hundred hectares of forest per year.

Ten tree nurseries are needed to be in full exploitation and to produce one million of plants per year during 15 years, to compare to the two tree nurseries existing in 2009. At minima; all the year, five people are to be employed on each tree nurseries.

In the 1950 years, more than ten tree nurseries produced plants for the forestation. Today, only two are operational and produce exotic, native and endemic plants. One tree nursery need about 0,75 hectare and can produce about 100 000 plants per year.

About ten villages (among the hundred of villages on Rodrigues Island) could be put in exploitation, each of those to produce about 10 000 plants per year: species that are easy to produce could be produced by those village tree nurseries. The species that are more complicated to produce should be managed by the ten big tree nurseries.

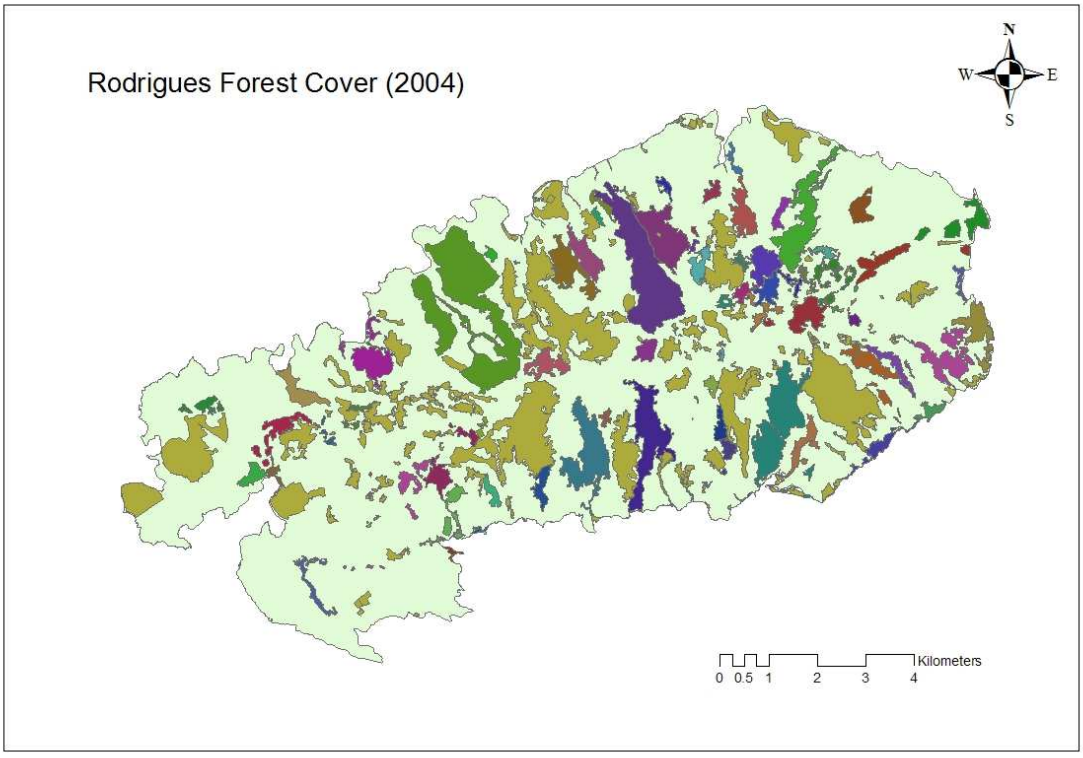
Here is a list of plants (endemic & indigenous) that has been planted in the restoration areas in Rodrigues.

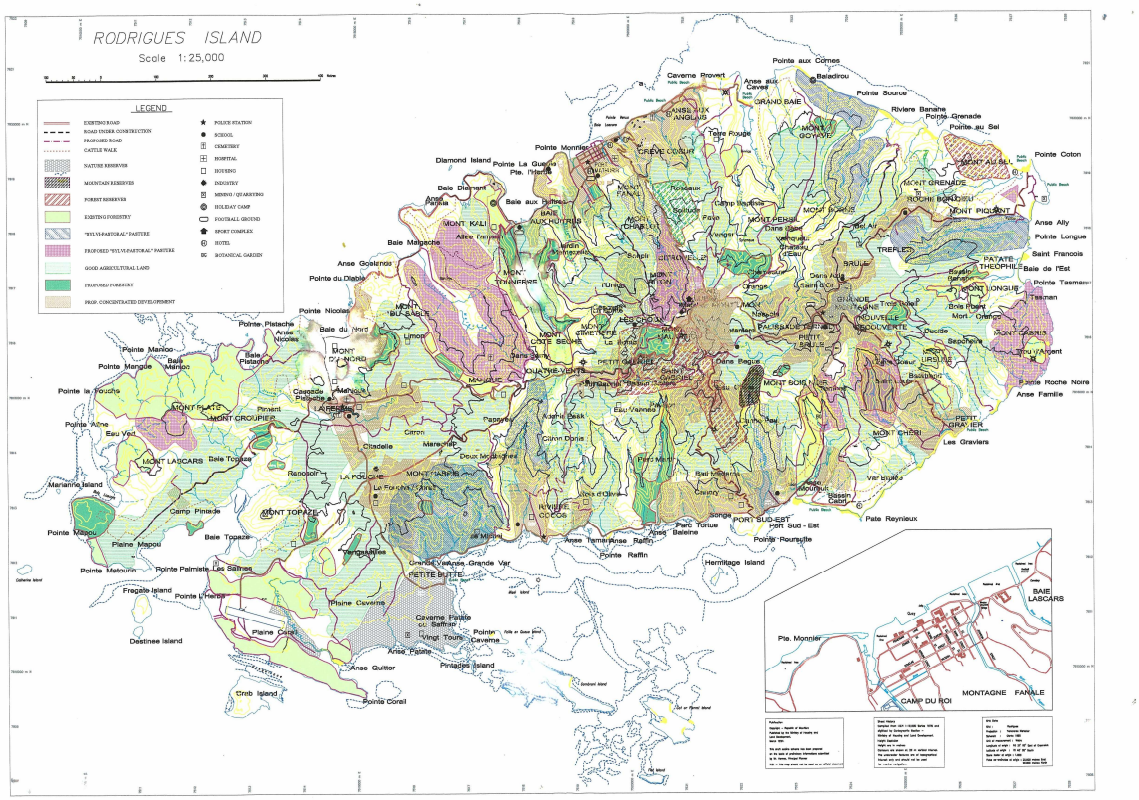
Obviously the list is not exhaustive and useful species could be added after careful studies. The ones marked by asterisks are those that are easier to produce and therefore could be done by village nurseries.

1. Gastonia rodriguesiana - Eendemic to Rodrigues – Bois blanc
2. Tanulepis sphenophylla - Endemic to Rodrigues
3. Pleurostylia putamen - Endemic to Rodrigues – Bois d'Olive petite feuille **
4. Terminalia benzoë - Endemic to Rodrigues – Bois Benjoin **
5. Diospyros diversifolia - Endemic to Rodrigues – Bois d'Ebene
6. Foetidia rodriguesiana - Endemic to Rodrigues – Bois Puant
7. Turraea laciniata - Endemic to Rodrigues – Bois Balai
8. Dictyosperma album – Endemic to Rodrigues – Palmiste blanc
9. Hyophorbe verschaffeltii – Endemic to Rodrigues – Palmiste Marron
10. Pandanus heterocarpus – Endemic to Rodrigues – Vacoas.**
11. Doricera trilocularis - Endemic to Rodrigues – Bois Chauve Souris**
12. Mathurina penduliflora – Endemic to Rodrigues – Bois Gandine**
13. Clerodendrum laciniatum – Endemic to Rodrigues – Bois Cabri**
14. Antirhea bifurcata – Endemic to Rodrigues
15. Latania verschaffeltii – Endemic to Rodrigues – Latannier jaune.**
16. Dodonaea viscosa - Native To Rodrigues - Bois Gournable **
17. Cassine orientalis – Native to Rodrigues – Bois d'Olive.**
18. Fernelia buxifolia - Endemic to the Mascarenes – Bois Bouteille
19. Ficus reflexa - Native to Rodrigues - **
20. Ficus rubra – Native to Rodrigues**
21. Myoporum mauritianum – Endemic to Rodrigues **
22. Premna obtusifolia – Native to Rodrigues – Bois sirop **
23. Scolopia heterophylla – Endemic to Rodrigues – Goyave marron.
24. Trichosandra borbonica*
25. Thespesia populnea – Native to Rodrigues – Bois Mapou.**
26. Sarcanthenum coronopus – Native to Rodrigues**
27. Lyceum tenue – Endemic to Rodrigues
28. Asparagus umbellulatus – Native to Rodrigues – Asperge marron.
29. Dracaena reflexa – Endemic to Rodrigues, Bois Chandelle **
30. Tournefortia argentea – Native to Rodrigues – Veloutier argente
31. Hibiscus liliiflorus – Endemic to Rodrigues – Hisbicus de Rodrigues
32. Poupartia castenea – Endemic to Rodrigues – Bois Lubine
33. Eugenia rodriguesensis – Endemic to Rodrigues – Bois de fer
34. Canavalia rosea – Native to Rodrigues – Liane cocorico.
35. Pisonia Grandis – Endemic to Rodrigues

36. Carissa spinarum – Endemic to Rodrigues – bois rond
37. Pittosporum balfourii – endemic to Rodrigues – Bois begasse**
38. Sideroxylon galeatum
39. Psiadia rodriguesiana
40. Sarcostemma cf. odontolepis
41. Scutia myrtina
42. Scyphochlamys revoluta – endemic to Rodrigues – Bois Mangue
43. Securinega durissima
44. Senecio boutonii
45. Toddalia asiatica – native to the Mascarenes – Patte poule piquant, Bambara
46. Vepris lanceolata – Patte poule, Rampoule
47. Sophora tomentosa
48. Obetia ficifolia
49. Badula balfouriana – endemic to Rodrigues –Bois Papaye

Land Management should integrate the necessary areas for each tree nurseries, as well as a detailed plan of the annual location, areas and cadastral identification numbers of Rodrigues forests to be planted.





At the beginning, implanting ten sites, each of ten hectares of forestry projects, in immediate connection with ten tree nurseries, acting as natural bioreactors spreading soon large amounts of seeds.

Considering the successful processes of reforestation conducted on the François Leguat Site, after three years, the WWF and the manager observe that the whole site acts like a bioreactor which engages a natural regenerating phenomenon in his immediate environment. Seeds are naturally are spreading around.

So, we have to locate with a strategic geographical intelligence the ten sites of forestry on the Island, so they will act as ten natural bio reactors spreading seeds around. Assuming that these ten sites are in immediate connection with the ten tree nurseries, the ten teams of craft mans will have a first task of forestry in the immediate surrounding of the tree nursery.

Ten teams of 43 craftsmen, a whole army is needed to realize this project, 430 direct employments in view during 15 years

Ten teams of around 40 craftsmen1 are to be created in order to reforest ten different sites of one hectare per day. At the beginning of the raining season (November, December, January), reforestation process is undertook. Those ten teams should be able to reforest about two hundred hectares per year. This taskforce of 400 workers are to be operational during this period of the year, each year during 15 years. This task force should be originated from people who are seeking for work on Rodrigues, as well as fishermen who are seeking for activity during the period of restriction of fishing. At minima three people are to be employed to recruit, train and manage one team of 40 workers.

[1] Extract from 2007 seminar : "40 man per day are needed to reforest 1 hectare. There are around 26 officers and 150 craftsmen who work at the forest department and around 18 persons from the Mauritius World Wildlife Foundation. "

A team has to be created as a Biomass Rodrigues Agency, in order to drive the whole global process. The permanent team need:

- one director,
- three technicians in charge of the global planification and coordination process,
- one financial technician in charge of the financial incentives for the global reforestation.
- three people are to be in charge of the education, communication and training programme in direction of the whole community of the Island

A global project for reforestation imply an investment of about 3 875 000 euro per year during 15 years

In order to coordinate, produce, plant and monitor 1 000 000 plants per year during 15 years, based on 3 Euros (120 Ruppes/plant), the financial investment is about to be 3 500 000 euros per year, valeur 2009, and of 375 000 euro per year for the Biomass agency (Action plan, Observation, Result, Ajustment, Propective, Financial Coordination, Information, Training)

This agency could be a Rodriguan ONG composed by the private sector, ONG as WWF, Communities, and Enterprises contributing to the CSR (Corporate and Social Responsibility). This board coaches a team which main mission is to organize the funding and the "mise en oeuvre". For example, each year, the main funds proposed by the European Union for Rodrigues" are going back because there is a lack of project to be funded.

ANNEXE – Extracts of the ARER 2007 Global Survey about Energy for Rodrigues Island concerning biomass potential and applications

Authors : F Al Shakarchi – Christophe RAT – 2007.

Rodriguan Contributors during the five Working Groups:

Pierre Louis	Jean-Claude	Chief-commisser office	Officer in charge
?? Oozeer	Mohammad Yousouf	Meteorological services	Officer in charge
?? Bothile	Stephen	National Coast Guard	Officer in charge
?? Hang siam	Joseph	Commission for Agriculture	Departmental Head
Perrine	Rosaire	Independent	Adviser
St Pierre	Jean-Noël	CEB	Engineer
Yetty	Surandra	CEB	Officer in charge
Soobadoo	Christophe	Construction company	Manager
André	Aurèle	François Leguat Reserve	Manager
Albert	Alex Salomon	Water Resources	Officer in charge
Meunier	Hugot	Forests	Officer in charge
Alain	Pierre	Pompiers	Officer in charge
Gebert	Gaëtan	Police	Officer in charge
Tolbize	Mario	IRERO	Area Manager
Hung	James	Rotary Club	Economic Actor
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Hee Hong	Davis	Commission for Public Infrastructure	
Perrine	J. Nachaniel	Commission for Public Infrastructure	
Soonarane	Pradeep	Ministry of Public Utilities	Deputy Director, Technical Services
Colin	Jean-Paul	Chief-commisser office	Departmental Head
Meunier	Dario	Bambou villa	Tour operator
Capdor	Jean-Marc	Fisheries	Assistant controller
Law San	Joseph Law Thion	Commission for Public Infrastructure	Draughtsman
Matadeen	Chandrasen	Commission for Public Infrastructure	Departmental Head
Feliure	Jérôme	Services agricoles	Senior Agricultural Officer
Begue	Berno	Coton Bay	Maintenance
Castel	Marie Lindsay		Conseillère - Femme & développement de l'enfant
Juste Meunier	Rachel	Rodrigues Tourist Office	
Leopold	Patricia	Cadastre	Surveying and mapping assistant
?? R. Bhewary	R.	Rotary Club	Bulletin officer

Biomass – a separate organisation of key players, an economic plan, an essential short-term monitoring of land usage

Monitor the division of land usage between forest, agriculture and breeding. Quantify and closely monitor the general reforestation programme. Develop the reforestation programme and the economic sector in greenhouse gases and in CDM/CC. Organizing the group of key players (those involved in economy, the Forest Commission, WWF, etc.) training, animation and planning. Organizing reforestation by sector, prepare and develop jobs for the collection and transformation process of wood. Communicate and coordinate the plan to the population and key players and mobilizing those concerned.

The technical input about Biomass and Energy presented the following figure :

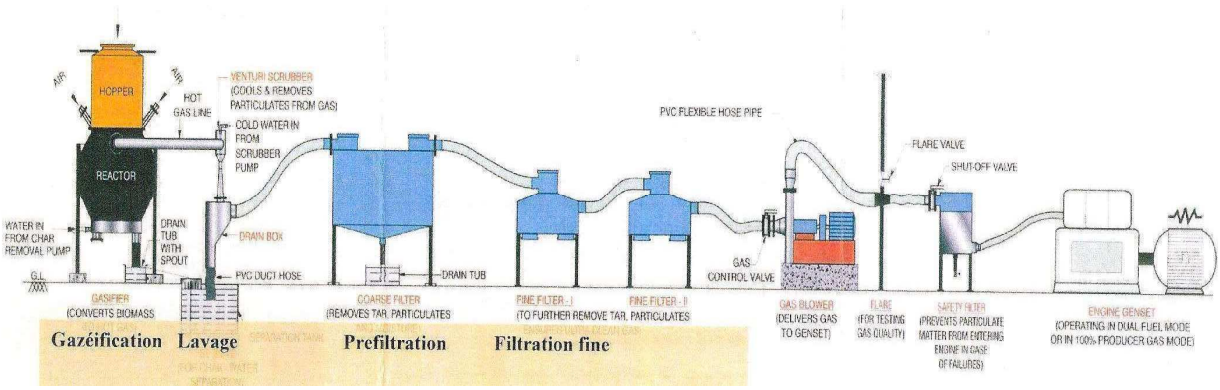
Wood-fired power station and gasification

Besides economic development and climate change issues which are part of deforestation, the wood-fired power station could also participate in reducing greenhouse gaz emissions. The technology of biogas is very reliable. They both offer the advantage of being able to provide the base of the CEB load curb and are not intermittent energies like as windpower or solar panels. In the Indian Ocean, bioenergy is implemented in Madagascar through a robust and well adapted Indian technology which is used by the company 'Bionerr'. These operations are being developed throughout the world, particularly in India. They are sustainable as long as the ressources come from wood or vegetal waste or from controlled wood production organisations in forestry or agriculture.

Technology presentation - Source BIONERR :

« Gasification is the chemical process that transforms solid biomass into a combustible gas. It is possible to produce biogas from all sorts of biomass: wood, corn cobs, rice bales, nutshells, etc. This could be used for thermal or electrical energy. 3, 5 kg of wood transformed into biogas is equivalent to 1 litre of diesel oil or 1 kg of gas. » It is possible to set up a power station ranging from 9kW to 1 MW.

Figure 2: gasification synoptic - source BIONERR



The advantages of biogas are: high productivity, green energy, no smoke emissions. Biomass is a source of renewable energy.

Thermal energy: gas is produced in a reactor and passes through a coarse filter before being used in a burner. Possible usage: heaters, ovens, dryers.

Electricity in dual fuel mode: the bio gas is produced in a reactor. It then goes through fine filters. It is injected to a standard diesel generator through a T pipe. This technology saves up to 70% of diesel use. It is a flexible solution which usually provides ROI in less than one year.

Electricity in 100% biogas mode: the biogas is produced in a generator. It then goes through fine filters. It is then used in an engine which has been specially designed for this purpose. Advantage: diesel is no longer needed therefore it is very economical. Disadvantage:

investment is higher as these engins are manufactured in small numbers. This solution is less flexible as the consumption needs to be as high as 50% of the nominal power.

Technical features for a 1Mw unit (source : BIONERR)

- Wood consumption is on average 1.3 kg per kWh
- Yearly operating time is 8140 hours. (Switched off : 2 hours every two days for cleaning, 12 hours per month for maintenance, 5 days a year for maintenance)
- Effective Electrical Power is 800 kW.
- Total electrical generation is 6.5 GWh per year
- Total heat generation is 12 GWh per year.
- Wood consumption for such production is 8450 tons.
- Equipment life-length is about 20 years.
- Yearly maintenance and operation costs are 5% of investment.
- Maintenance: easy, as complex maintenance concerns only the engines.

Global electricity generation potential by BIOMASS

Concerning the biomass ressources, an assessment must be carried out in association with the Forest and Water Boards to establish production capacity from the available forests.
In Madagascar, for example, Eucalyptus tree forests produce between 5 and 25 tons per year and per hectare depending on their situation. In India, high density and irrigated Eucalyptus tree plantations can produce up to 100 tons per hectare per year!

On the basis of a 10 ton per year and per hectare production, 845 hectares are needed to supply the 1MW unit in Rodrigues.

In order to reach the 20% humidity rate necessary for the production of biogas, a 3 month stock must be set up in order to prepare and dry out the wood. In other words: 3,000 tons of wood or 10 000 steres. A 2 hectares area is sufficient to install both the necessary biomass stock and the plant itself.

Set up and operating costs depend on local costs and the chosen level of automation in biomass preparation process. A detailled survey should be carried out at a later stage.
Note that the current forest surface availble for exploitation is 3500 hectares. Reforestation could generate an increase to 4,500 hectares.

Gasification potential could be estimated at 3 MW by exploiting around 50% of this surface area. Choosing one specific variety of wood for energy could eventually triple this potential outcome.

Furthermore, there is potentially an extra source of energy for 1MW by using organic waste, such as vegetal waste and animal manure.
Implementation cost – Economic and environmental impacts
The initial investment cost is around 1M€.
Fuel cost could be closer to 1000 Rs/Ton than 2000Rs/ton. All calculations use 2000Rs/Ton to be sure not to under-estimate costs.

Operation and maintenance costs should be around 5% of initial investment.

Table 1: cost and environmental impact for a 1MW wood gasification power system

Biomass system	Wood gasification power system
Installed capacity	1 MW
Effective capacity	800 kW
Initial investment	42 MRs

Life length	20 years
Depreciation time	15 years
Yearly depreciation cost	2.8 MRs
Yearly electricity generation	6.5 GWh
Yearly heat generation	12 GWh
Fuel consumption	8 450 Tons
Fuel cost (assuming 2000 Rs/Ton)	19 MRs
Operation & maintenance costs	2.1 MRs
Total costs, depreciation incl.	24 MRs
Generation cost per unit	3.7 Rs/kWh
Yearly GHG emissions	0
Yearly saving on fuel bill for CEB (HFO)	21 MRs
Yearly GHG emissions reduction	4 250 Ton CO2 eq
Yearly GHG emissions cost saving (1TCO2 = 840 Rs)	3.6 MRs

Schedule and partnership

- All forest and agricultural sectors must be involved in the reforestation programme and in the collection of agricultural waste such as corn cobs. Is it possible to envisage local fishermen becoming involved in the reforestation campaign as well as forest maintenance and wood collection during their low season.
- For electricity production: CEB
- For a general feasibility study: Consultancy Firm
- For land reservation (2 hectares per MW unit) : inscription in the Global Territory Plan by the local authority

Schedule:

- 2008: detailled study and localization of 2 units according to wood collection and connection to the CEB Medium voltage network
- 2009-2010: technical study and detailed set up of the first 1 MW unit
- 2011-2015: technical study and detailed set up of the second 1MW unit
- 2016-2025: study and detailed set up of the third 1MW unit
- 2026-2050: study and set up of the fourth 1MW unit

BIOMASS: reforestation and biomass development, as a mutiple economic sector and a key action to prepare to climate change

The story of reforestation in Rodrigues has implanted a real know-how there, means and a precious wood capital to be sustainably managed, with the assistance of the Rodigues Regional Assembly forestry department

Through time, the island has undergone serious deforestation, which reached a peak in the 1970s. The primary forest was entirely destroyed. A reforestation policy has then been launched, and due to current major droughts, the « Piquant Loulou » wood (Acacia Nilotica) was chosen as it can grow in arid conditions.

Table 2: « Piquant Loulou » (Acacia Nilotica), wind indicator, how to consider the future of this wood

A 1983 FED programme enabled the pursuing of the reforestation policy and the planting of fodder for pastures. Varied species has been used, such as the filaos, on some coastlines, and the coconut tree in other areas. The eucalyptus has been mostly planted in the upper parts. More recently, a rehabilitation policy has been set up to gradually encourage the reintroduction of endemic species in exotic forests. This work has been carried out for years by the Forestry Department of the Regional Assembly of Rodrigues. This acquired experience has been beneficial to the project and to adapt this reforestation policy to the issues of climate changes. Finally the aim is to set up a wood sector with a diversified economic vocation.
Table 3: wooded surfaces in Rodrigues – a map of the forest department

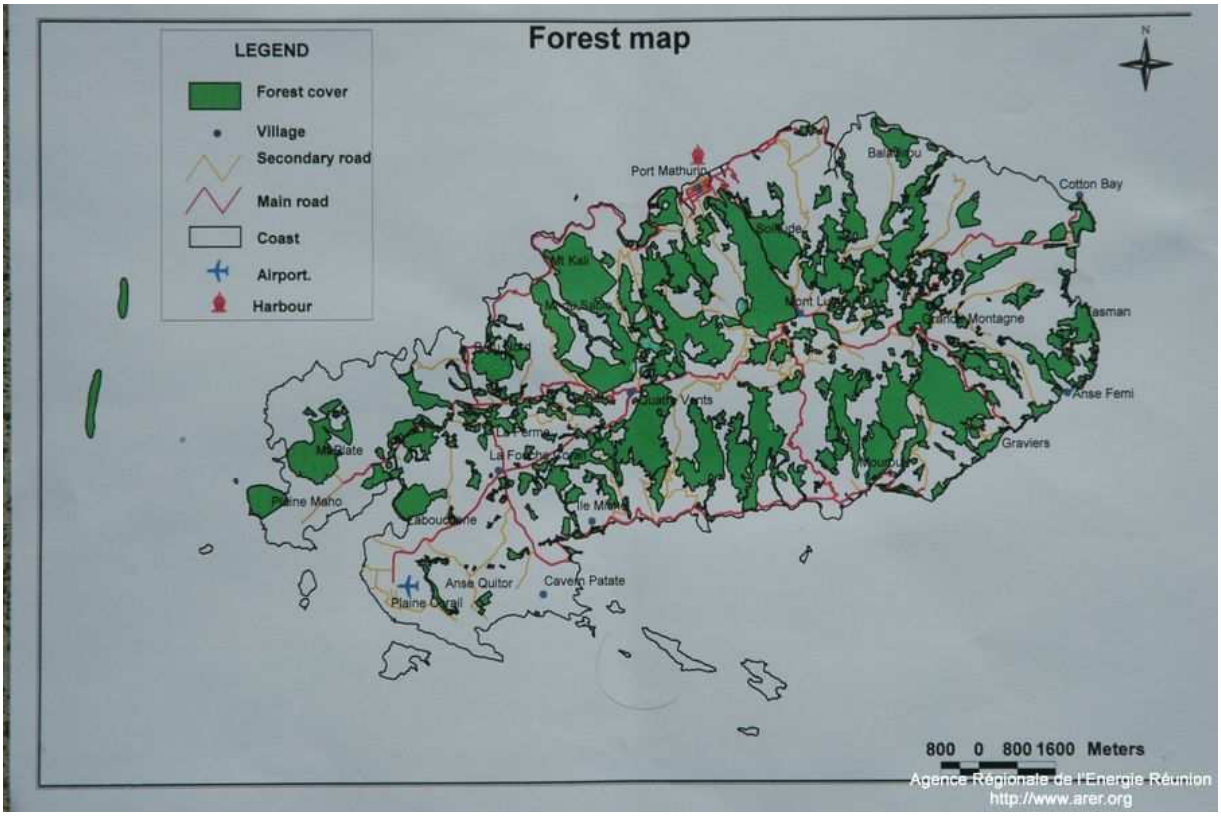
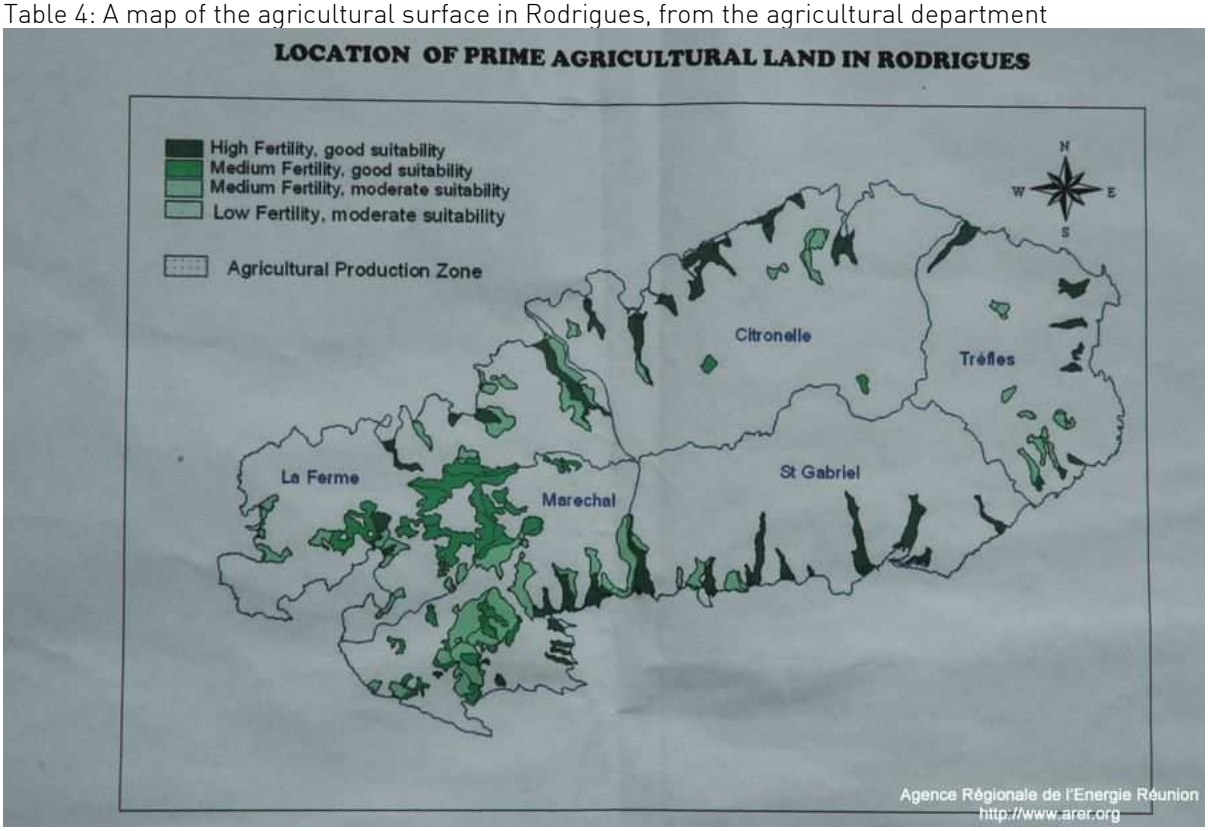


Table 4: A map of the agricultural surface in Rodrigues, from the agricultural department



A private initiative for the reforestation of endemic plants the capitalizes the acquired experience: the anse Quittor tourist park

In the framework of the tourist park" Francois LEGUAT's giant tortoises and grottos reserves " in ANSE QUITOR, an endemic floral rebuilding work has been launched. The aim is to plant primary vegetation again. With the Mauritius Word Wildlife Foundation contest, and the

collaboration of a network of key players in Rodrigues, around 106,000 young plants have been reintroduced up to October 2007. A surface area of 16 hectares has been replanted in two years. There is a 90% success rate. We then have to calculate the carbon equivalent. With the experience acquired on the plot, in 5 years, the Reserve will be a totally recreated forest. We can observe that this private project, which can benefit from acquired experiences, has succeeded in good conditions, with a 90%-growth rate of the young plants. Approximately 8 plants per m² have been planted at the beginning if the rainfall period (in November), to give them time to grow before the dry season (in April), with a 14-member team during the planting period.

Table 5: example of replanted endemic plants

Some of the species represent a problem for water resources

The eucalyptus, and other imported stumps, involves environmental problems. The primary forest in Rodrigues is made up of endemic species constituting an « ever green» canopy, which collected and kept the waters. The island was desert but the rivers were permanent. Currently, between exotic trees and the population increase, the water resource is diminishing. The "var" is an endemic species, a perfect wood for ships, for stems, stern-post and marine carpentry. Another example is the Terminalia (Razuna), a huge species which covers an extraordinary surface. The compatibiltity of the consumption of these tree species must be assessed.

There has been a population increase of 12,000 people between 1970 and 2007. The latter have growing water-use habits and this explains the pressure on the water resource.

The surface area at stake, reforestation potential, wood availability, today's means, priorities

In 2007, the wooded surface of Rodrigues Rodrigues island amounts to around 3,500 hectares, on a total surface of 10,000 hectares for the whole island.

The quantity of available wood wastes would amount to approximately 150, 000 tons. It is known and we can find an inventory of the existing forests with the different species at Mr Hugo MEUNIER's department. These documents can be taken. Ref. the map of today's forest area, today's agicultural zones. A survey study, the « global survey », is being carried out at the moment.

An approximately extra 1,000 hectares of forests is considered as viable, which would finally lead to a wooded farming surface of 4,500 hectares.

The existing tree nurseries, covering 1.5 hectares, can annually yield up to 200,000 feet. Around 40 men per day are needed to reforest 1 hectare. There are around 26 officers and 150 craftsmen who work at the forest department and around 18 persons from the Mauritius World Wildlife Fondation. The Anse Quitor reserve also works with private local key players to prepare the plans.

Current reforestation capacity is around 100 hectares per year, due to existing means, which comprise the forest areas to be replanted (Progressive removal of exotic plants and replanting endemic ones).
The potential focus is to reforest the south-south-western region. A village forest project is considered. Other specific wood sectors could be considered, such as the cultivation of coconut trees2, of « Bâton Mourong »3, of bambous (A purifier and big materials for various products, Neem4, Jatropha5, to diversify some economic implementations)

(2) The coconut tree

Fighting against erosion on the coasts. These coconut plantations could be rationally exploited for the production of raw material and biomass gasification. The whole array of derivatives could be used : roots, trunk, leaves, coprah, nuts, seeds, 'chou', fibre, light and resistant coconut wood planks, coconut oil, coconut-shell jewelleries, kitchen ustensils, palm sugar, refreshments, coconut milk,etc. It is a very important potential economic sector.

(3) **Moringa oleifera, alias « baton Mourong »**

A multiple-use tree: the 'néverdier' (Moringa oleifera) (also called anamambo, moringa, morongo, or Horseradish-tree, Ben-oil tree, Drumstick-tree in English, Malunggay in the Philippines and saijan in India) is a little tree which can be 10m high. It is a very useful tree species from the north of India and the arid regions which generally looks like the acacia which withstands droughts well and has a rapid growth. The ayurvedic Indian tradition stated that the Moringa leaves cured more than 300 diseases.

Modern science has confirmed this belief and has added that this plant has an extra nutritive value: in India, the Moringa is a food-producing plant cultivated for its fruits, which are eaten cooked and, exported fresh or canned. In the Sahel, the Moringa oleifera leaves are eaten as vegetables while the Moringa stenopetala leaves are a basic dish of the Konso people in Ethiopia. Nutritional tests have shown that the Moringa oleifera leaves are richer in vitamins, minerals and proteins than other vegetables. They can be a whole food as they contain twice as much proteins and calcium as milk, as much potassium as a banana, as much vitamin A as a carrot, as much iron as beef or lentils and twice as much vitamin C as an orange. Many programmes use the Moringa oleifera leaves against malnutrition and its related diseases (blindness, etc). Moreover, the Moringa seeds contain cationic polyelectrolyte which has proved its efficiency in the treatment of waters (eliminating turbidity), by replacing alumina sulfate or other floculants. These leaves have two advantages: substituting imported floculants by a local product, which is easily accessible, enables an important saving of the currencies of developing countries. This floculant, contrarily to alumina sulfate, is totally biodegradable.

We can also extract from these seeds an interesting vegetable oil mstly in Africa where a lot of countries lack vegetable oils, an dit is also an interesting raw material for the beauty industry (soap, perfume). A mixed use of moringa, for the production of oil and floculant agent, is possible as the oil cake coming from the extraction of oil keeps its floculants capacities. Its roots are used to produce a seasoning ingredient. Other potential used of the moringa, such as in animal food, as a plant growth hormone, as geen manure, in herbal medicine or as paper paste are all the subjects of various researchers.

The Moringa can be found in very arid zones such as the Sahara, but it also likes wet sub-tropical climates. Its very deep-growing roots enable it to withstand lack of water for months. In Senegal, it is called "Nébédaye", which would come from English : "Never die". When it is cut or when the young plants are burnt by the sun, they grow again as soon as the first rainfalls resume. It can be sown, planted from pricking outs or planted in the field, or from cuttings. It can be cultivated extensively for the production of seeds (seeds or oil production) or intensively irrigated for an optimal production of leaves (very nutritive) with a harvest every 6 weeks! This tree grows very quickly, up to 1 metre per month! It is easily planted, the '"Ananambo", very much present in the six provinces of Madagascar (Fianarantsoa, Toliara, Mahajanga, Antsiranana and Toamasina), is planted from cuttings. Its mass replanting contributes to the preservation of the environment and this tree is an efficient fire-wall. Several organisations have isolated the active protein of the Moringa floculant to easen up its use in water-treatment plants but also for alguae aquaculture, paper paste plants, wine caves and the mining sector. The production and use of the Moringa in real economic conditions are being set up. (Source Wikipedia)

(4)Neem, a tree to be planted in your garden

Neem is an insecticide whose active matter, azadirachtine, is isolated from a tree seed, the Neem. If the leaves are used as medicine to cure malaria, its fruits are a perfect natural insecticide, not harmful to men and animals. It could become a biological solution for the fight against Aèdes Albopictus, the vector to several diseases such as malaria and Chikungunya. Neem oil is used to make all sorts of products such as pesticides and insect repellents. Its oil is famous for its efficiency to fight mosquitoes and flies, mites, nematodes, mushrooms and bacterials. Among them, there is Aèdes. Its active substances radically eliminate mosquito larvas, blocking the metamorphosis from the larva status to that of an adult. This tree is found in great quantites on Reunion Island, mostly in Saint Paul, and Etang Salé, where the ONF and the CIRAD have planted millions of items.

(5) Jatropha Curcas, a plant with various uses

Jatropha curcas L. (Euphorbiaceae) - Pignon d'Inde– from the Barbados. The Jatropha type comprises 170 species and most of them come from tropical America (MABBERLEY, 1993). The name was coined from 'iatros' = medical and 'trophe' = nutrrent. It is an herbaceous plant of 50 to 70 cm high which can also reach 3 m high under good conditions. Its leaves are palmate and are yellowish green. The bear three-shelled fruits. The seeds are 1 to 2 cm long and are black stripped. They are very toxic seeds: 17 to 40 % oil. emeto-cathartic oil. Toxalbumine (Curcine). Purgative, drastic, venemous. Posology: 3 to 5 shelled and lightly grilled seeds. Root barks: rubefiant. Stem juice against Laffe (venomous fish) bites. Leaves used in cataplasm on engorged breasts. This oil is used as ointment for haemorrhoids, rhumatisms, scabies; herpes, hydropisy (DARUTY, 1911). - Source: Medicinal plants sheet of Madagascar by Pierre Boiteau and Lucile Allorge-Boiteau.

The production of green fuel, as considered by the malagasy government, from the Jatropha will lead to a green fuel which is available for generators, vehicules and boats, and this would greatly reduce the territory's energetic dependence on fossil fuel. It would also ensure the emergence of a renewed rural economy and would save the country's finances regarding the increased cost of oil. This plant has other qualities and is present amost everywhere in Madagascar: in soap production, to cure insect bites, urticant caterpillars and itching powder, furuncle, in paper production with bark and fibres ...)

« Priorities must be set for land management policy: particularly reforesting against climate change » - dixit the symposium participants

"These contribute to the prevention of soil erosion, the creation of windbreaks, the provision of wood for furniture and other potential commercial activities, and improvements in the quality of the island's visual physical surroundings. Natural reserves also extend to approximately 64 ha. "
The replanting a natural layer on the island is a major issue for the resistance of Rodrigues Island against climate change, on the economic level, which can greatly create employment. It can also fight against land erosion, recreate the water and soil conditions, and encourage the creation of wood resource which could be used with various objectives: wood energy and craft wood, medical wood, plants for perfume, etc.

The choice of endemic species which are more adapted to the arid and windy conditions of the island can enable a better «preparation » of the ecosystem to the climatic changes on a short-term forecast by the IPCC. The coming thirty years will be the last phase of the reafforestation project and will thus prepare the natural layer to adapt to climate change.
Rodrigues Island now entails political, technical and land management choices: « How can some order be brought and how can the sharing process be carried out regarding pastures, forests and agricultural lands? »

One of the main problems underlined by the agents in Rodrigues is: Rodrigues is covered with «pastures everywhere, villages everywhere, forests everwhere". An educational and training programme for the citizens and farmers has been set up, and it aims at changing attitudes and introducing good practices by the Forestry Commissioner. But it is not enough.

It is very important to be able to manage the allocation of the lands and share them between forests, pasture and farming. To do this, the livestock farming conditions, the production of fodder, and the allocation of lands for these activities must be analyzed. It is clear that the lack of incentives in this field will make this situation last. But how can livestock farming practices evolve to rationalize the use of lands? Cows are mainly bred for the production of meat, and this is also the case of sheep and goats. The milk industry is inexistent.

Various scenarios are standing out, the functions of the decisions to be taken

Scenario 1: current conditions are lingering.

The reforestation policy as an adaptation procedure to climatic changes is not possible. The island is exposed to strong difficulties regarding climatic changes, as there is still a strong part of the natural cover which has been eroded, and this is made worst by present pasture techniques.

Scenario 2: Meat production is still the main aim.

Pasture surfaces are allocated per village and in this framework, cattle, cows, sheep, she-goats develop freely. A balance must be managed between the number of animals and the surface area of the pastures. The amount of plots to be afforested is planned and the various reforestation programmes are part of a general biomass programme for Rodrigues Island. It is supervised by the forestry department, WWF Mauritius, and the various economic and social partners in Rodrigues.

Scenario 3: A diversification of this industry has been set up to produce milk, after meat which is already done.

Scenario 2 is enriched by the setting up of meadows meant for the production of fodder. Livestock breeding and the animals are grouped and the meadows produce hay to feed the animals. The reforestation programme is done in parallel with diversification of milk products for the Rodriguan market: to reduce the pressure on the lagoons, thanks to the growth of Biomass on the island.

In case it is scenario 1, Rodrigues Island will definitely not be prepared to climatic changes. If scenario 2 or 3 arises, a minimum of 1,000 extra hectars of reforestation is possible. The National Physical Development Plan is the key to this work. It will have to be done with the help of the population.

This decision will finally be taken by the Regional Assembly of Rodrigues.

Diversifying and reinforcing the means

In the framework of the reforestation plan, the forestry commission has up to now taken care of forests. So as to accelerate the process, new means must be thought, and the work could be extended to the other partners, that is, to the economic sector. The farming, harvesting, transport, transformation and sales jobs available are profuse.

An economic activity of existing wood cutting and transformation is necessary

If an existing forest management and rehabilitation campaign gradually discards the exotic species to promote endemic ones, an economic activity of the existing wood cutting and transformation will be necessary. A portable sawmill plan would have as objective the production of timber for joinery, wood framework and craftsmanship.

This would restrict the imported volume of wood (of poor quality). A project leader has proposed to organize and launch this activity. Wood wastes from this activity could be used in the gasification unit. The necessary technological chain is: Table 6: equipping the portable sawmill

- A mobile unit to square off the land and to reduce the volume until the wood can be carried on man's back up to the road
- A fixed electricity unit
- Costs : 450 000 rupees/transformation team
- Project leader: economic key players

(Reference: Logosol in Australie. The start equipment could comprise the Timberjig in a basic version that could evolve towards the Big Mill Basic (the first two ones work with a petrol chain saw and is mainly used to cut the wood in the forest to facilitate the transport) and finally the

sawmill Logos l M7 (a fixed place on our carpentry shipyard) equipped with an electric chainsaw for a better yield. All this costs approximately € 9 100.00 including the supplier's hauling in Rodrigues.)

Energy wood and gasification

Beyond the reforestation project which aims at economic development and adaptation to climatic changes issues, the energy wood industry can also participate in the decrease of gas emissions leading to green house effects. Biomass gasification technology is very reliable. It has the advantage of being able to function « in base » on the CEB load curb, and does not possess the intermittent characteristic of wind or solar energy.
In the Indian Ocean, it is used in Madagascar (based on a strong and adapted Indian technology, used for example by the Bionerr Company). These systems are developing everywhere, mainly in India. They have a lasting characteristic, as from the moment that the used resource comes from wood and plant wastes that have been recycled in silviculture and agriculture.

In what ways can the biomass policy become an operational programme fighting against climate change?

Reforestation is simultaneously a carbon collecting act, the recreation of a viable local climate, a major economic sector, an important source of energy production and a necessary adaptation of the island to climatic changes.

What can slow down the programme:

- Ill-known and not well spread centralised actions
- Few private initiative possibilities
- The length of the plantations growth
- Lack of finance and means
- Lack of political decisions to be taken on the sharing of land use
- Lack of communication with the population on the issues of climate change and the need to act on the economic plan and to adapt to climatic changes

The assets:

- A good experience acquired with very competent key players
- Available fundings in the MDP framework
- A potential of wood for an energy wood sector which is in harmony with the gasifcation system
- The reintroduction of endemic plants has started successfully
- Coconut trees, bambous, Neem and Bâton Mourong grow well and have very diversified economic and environmental potentials
- A strong political drive
- The wood sector, and more globally, the biomass one can contribute to the energetic autonomy of Rodrigues by using gasification, with a electric potential of 1 megawatt

Synthetic presentation of the global action programme to be set up in details in a future specific technical meeting with Rodriguan experts

Arbitrating the allocation of land among forest, agriculture and livestock farming, Quantifying and arbitrating the general reforestation programme

This task is to be carried out in a specific workshop grouping the concerned Rodriguan key players:

Setting up a "Wood" economic branch: General reforestation of the island with extra minima of 1,000 hectares of endemic plants, 2,000 hectares if possible, for a future total of 4,500 to 5,500 hectares of forest. This includes a constituent which aims at rehabilitating a surface area of exotic plants with endemic plants (1,000 ha), on a total surface area of 10,000 ha all over the island. The aim is also to organize an optimization of the reforestation and acheive a steady pace of 100 ha of reforestation of new areas per year and 100 ha of rehabilitation per year, that is, a reforestation programme spread on ten to fifteen years.

Sketch of figures to be verified and to be arbitrated by Rodriguan experts of the forestry department and th WWF and the François Léguat reserve:

- Evaluating the production of young plants for 100 hectares of new reforestation using endemic plants: 100*10 000*8= 8 000 000 plants for 100 ha (base : Evaluation of plant needs per m² : 8 plants/m² from the technique used by the François Léguat reserve).(Nota Bene: according to the communicated figures, 106, 000 plants for 16 ha replanted in two years, with a team of 14 persons, that is, for 100 ha, a need of 106 000*100/16= 662 500 plants.)
- Evaluating the production of plants per year for the reforestation of 100 hectares by removing exotic plants and using endemic one
- Taking into account the current capacity of the forestry department tree nursery, this implies that if the figures are confirmed by the rodriguan key players, there will be the creation of several nurseries and the multiplication of the teams working in the nurseries and on reforestation. Assessing the needs
- Setting up a "coconut tree" economic branch: Implantating a coconut tree outline all along the coastline, as far as it is possible, and this is a surface area which has to be quantified. A high hypothesis possible: a strip of land of 30 metres large all around the island (60 000m*30 =180 hectares of coconut tree plantations with an average density of 200 coconut trees per hectare). In a low hypotheis: 30% of the coastline strip could be planted, that is, about 50 ha representing potentially 10,000 coconut trees)
- Setting up a multipurpose ecological sector for the houses and gardens of the island: introduction of a bambou shrub, of two to three bâton Mourong plants, of a banana tree shrub, and of a Neem plant, on the 11,000 houses of Rodrigues, with multipurpose ecological functions.

Set up a 'village forest' project in each village

- Promoting this reforestation and development programme of the economic sector in greenhouse effect gas and in MDP/CC by quantifying the equivalent of carbon collected by the afforestation project
- Organising a platform of key players (Economic agents, Forestry Commissioner, Mauritus WWF,etc) training, organisation and planning
- Organising reforestation per sector, preparing and setting up the jobs related to collecting and transforming
- Communicating and discussing the plan with the inhabitants and key players and mobilising them on what concerns them
- Investing in a first, then a second biomass gasification units of 1 MW each, for the production of electicity and heat for the energy self-sufficiency of the island

Data to be gathered during detailed technical meetings on this specific topic:

Cost of the forestation teams, assessment of the annual pace of production of necessary plants

Positioning and booking the necessary nursery areas

ANNEXE – Le Neem, l'anti-paludéen et l'insecticide naturel, à la découverte d'un arbre aux multiples propriétés

Présent dans de nombreux pays sub-sahariens, le neem est un arbre aux milles vertus. Si ses feuilles servent de médicaments pour soigner le paludisme dans la pharmacopée traditionnelle, ses fruits, dont on fait de l'huile, sont un parfait insecticide naturel, inoffensif pour l'homme et les animaux.

Caractéristiques de cet « arbre universel »

Le neem, très présent en Afrique (et également en Inde), prend différents noms en Afrique de l'Ouest : Neem, Nim, Dému Buki, Dému tubab en wolof, kaaki, Leeki, Nim, Nuwakinin, Tirotiya, Miliahi, en pulaar, Neem, Nivaquine en serer, Goo,Guy en bambara, Tubabu tombohô, Tubabu tohoro, en mandingue ou encore Dongoyaro, en haoussa et Neem en moré (maure). L'arbre appartient à la famille des Méliacées et ne dépasse pas 10 à 12 m au Sénégal, mais peut atteindre 25-30 m dans son pays d'origine (l'Inde), selon la direction la Recherche forestière au Sénégal.

Dans le cas du Sénégal l'arbre est présent sur le sol du pays en affichant une biomasse des plus importantes du continent. « La population actuelle de neem (au Sénégal) peut être estimée entre 18 et 30 millions d'arbres », d'après les statistiques de la direction forestière. L'arbre y pousse bien sous un climat semi-aride, à semi-humide et supporte même les climats aux précipitations inférieures à 500 mm. Il montre peu d'exigences vis-à-vis des sols, s'accommodant des terres maigres, pierreuses ou sableuses. Il n'existe pas d'aires de plantation en régie dans les zones visitées.

Anti-paludéen et redoutable insecticide

L'Afrique souffre depuis longtemps du fléau du paludisme. Les vertus du neem sont un allié de taille qui permet de lutter contre, à travers l'élaboration du sirop de neem administré aux enfants. Et dans la pharmacopée traditionnelle, ce sont les feuilles de l'arbre que les populations locales font bouillir dans l'eau. Ces infusions font ainsi office de nivaquine. Sur le plan de la recherche en laboratoire, il est l'objet d'études approfondies, pour mieux percer ses autres mystères, notamment au sein de l'université Cheikh Anta Diop de Dakar (Sénégal), avec le chercheur spécialiste du groupe neem, le docteur entomologiste Lassana Konaté. Les feuilles sont, par exemple, parfois utilisées comme antiseptique.

A ce jour et depuis les années 80, explique-t-on à la Recherche forestière, l'usage du neem dans le domaine agricole est d'une efficacité remarquable en qualité d'insecticide. Il est jugé efficace pour lutter contre 100 espèces d'insectes et nématodes (vers). L'huile de neem est un produit naturel dont les extraits ont une action extrêmement toxique et non mutagène sur les insectes, mais reste inoffensive pour les animaux à sang chaud et les hommes. Les substances actives, qui éliminent radicalement les larves de moustiques, se dégradent par ailleurs rapidement sous l'action des rayons du soleil. Utilisée en pulvérisation, l'huile est obtenue à partir du fruit de l'arbre.

30 kg de fruits pour 3,75 litres d'huile

La récolte des fruits de neem se fait soit en cueillant les fruits de l'arbre, soit en les ramassant à terre. A l'intérieur, une, parfois deux, amande(s) brune(s). Après le décorticage, le vannage consiste à séparer les débris de coques des amandes pour en faire de l'huile. Au Sénégal, le neem est productif vers 4 ou 5 ans. Il atteint sa pleine maturité vers sa dixième année, âge à partir duquel, il produit en moyenne 30 à 50 kg de fruits par an. Pour ce qui est de la fabrication de l'huile de neem, 30 kg de fruits fournissent 13,60 kg d'amandes, qui pourront fournir 3,75 litres d'huile par un procédé de pressage artisanal.

Le neem, malgré ses nombreuses vertus et produits dérivés, n'est malheureusement pas exploité sous forme de plantations surveillées. Ce qui permettrait une production plus conséquente. La direction de la Recherche forestière préconise « des plantations avec des écartements de 10 m sur 10 m pour éviter les effets bordure. Ainsi dans un hectare, on pourrait avoir 100 à 120 arbres qui produiront annuellement au bout de 4 à 5 ans 3 à 4 tonnes de graines ». L'utilisation des feuilles, de la poudre des graines ou de l'huile soigne l'homme et protège les céréales et légumineuses en stock ou sur pied contre les insectes nuisibles.

L'importance du paludisme en Afrique et les crises acridiennes qui sévissent sur le continent justifient à eux seuls que soit développée une exploitation sans retenue du neem, l'arbre universel.

Table des matières

A global Forestry plan 2025 for Rodrigues Island

Architecture of project

- Filière : Outils d'intégration énergétique insulaire
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«Promouvoir la maîtrise de l'énergies et l'utilisation rationnelle des énergies renouvelables, et préserver les ressources naturelles locale dans une perspective de développement durable et d'adaptation aux changements climatiques »

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